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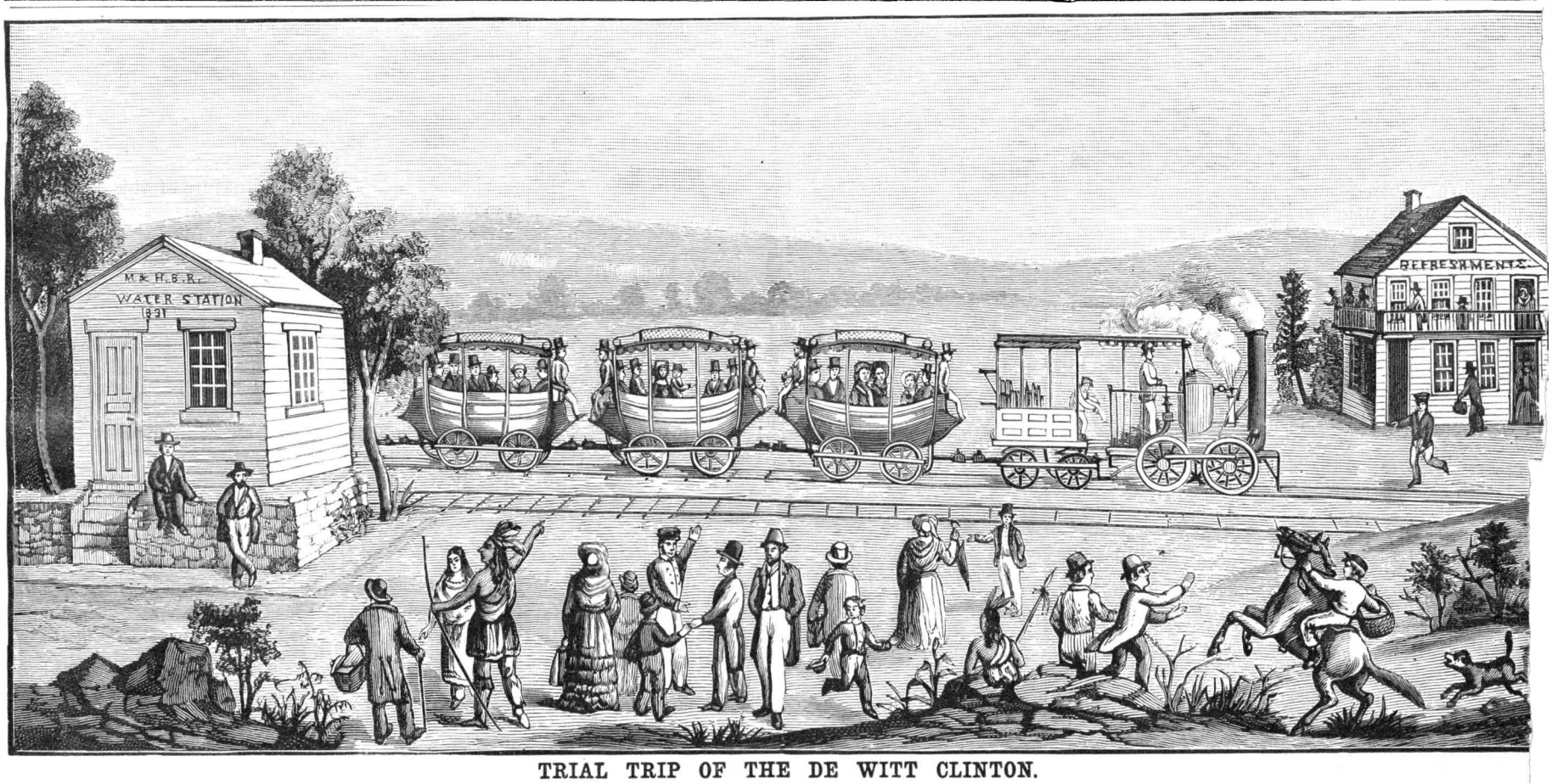

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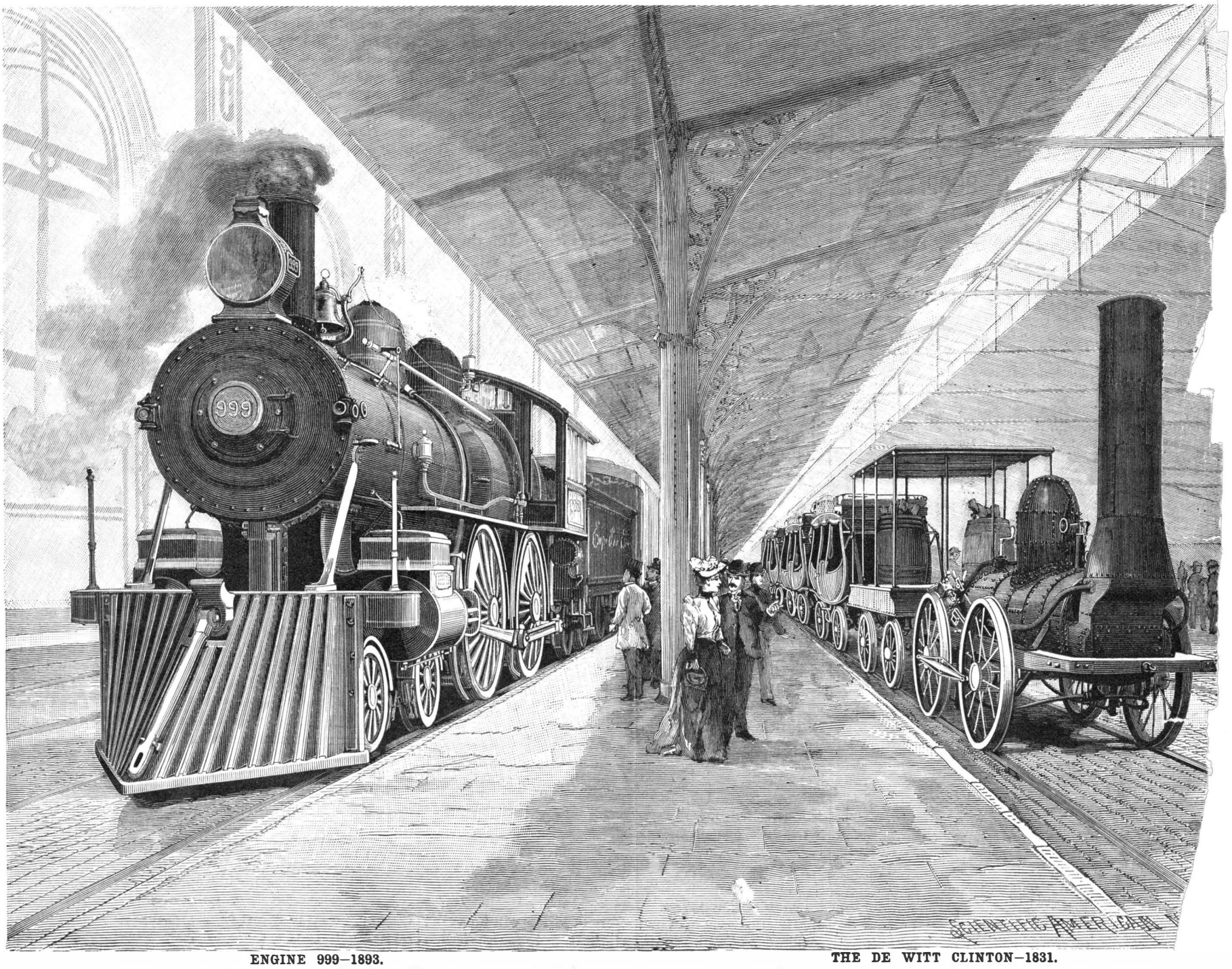

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COLUMBIAN WORLD'S FAIR EXHIBIT OF THE NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.—[See page 2

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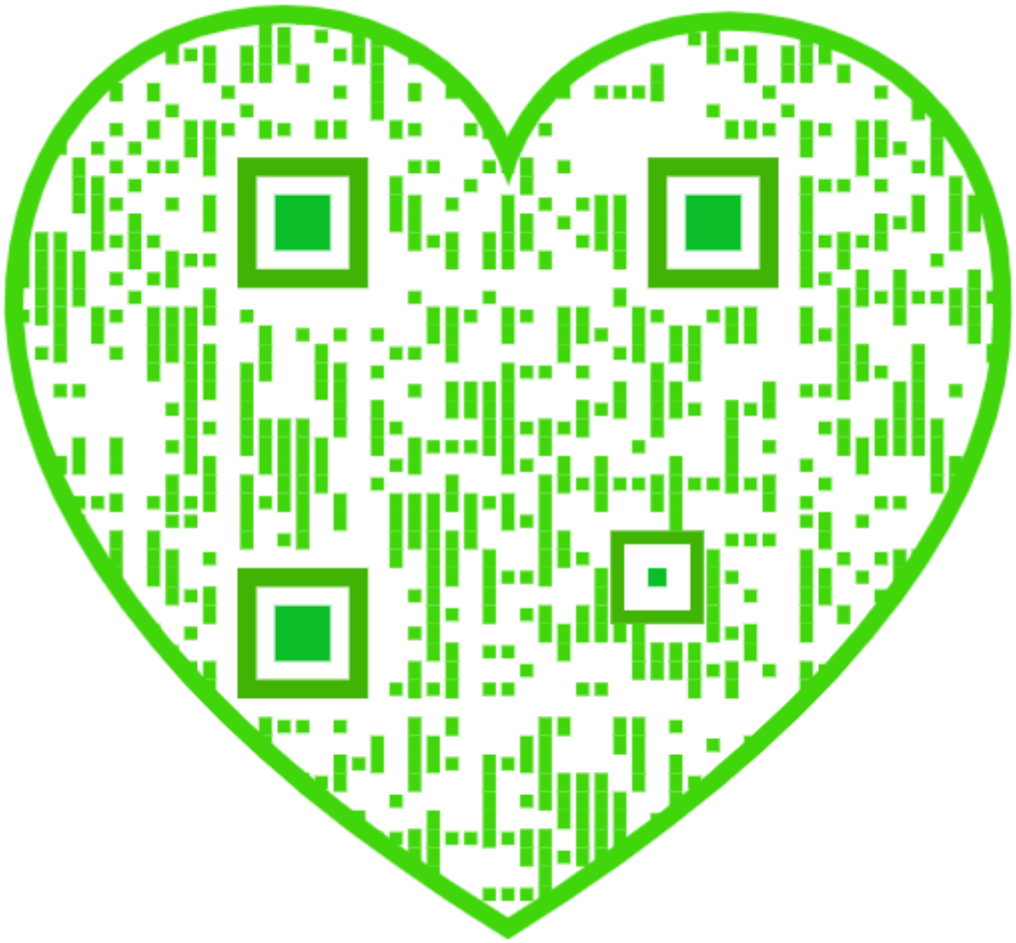

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OPENING OF THE WORLD'S COLUMBIAN EXPOSITION AT CHICAGO.

On the first day of the present month the Columbian World's Fair, at Chicago, was formally opened. The programme for its inauguration was simple and effective. It included music, prayer, poetry, and oratory, followed by an official reception by the President of the United States and the officials of the Fair and foreign commissioners. The music was rendered by a band of six hundred musicians; the prayer was delivered by the blind chaplain of the United States Senate, who, as he was led to his place upon the platform by his adopted daughter and faced the great audience, which he could not see, gave the requisite touch of pathos to the occasion. The principal oration was delivered by Director-General Davis, president of the Exposition. President Cleveland followed him in a very short address, warmly appreciative of the wonderful work which has been done at Jackson Park. On a table near his left hand was a gold telegraph key. As he finished his address, he pressed the key. The closing of the circuit marked the beginning of the Fair. The electric current started the machinery. The electric fountain began to play, some seven hundred flags were unfurled, and the White City, as it has been appropriately called, started into life. Its brief existence began with the pressing of the key by the President of the United States.

The Fair is designed to commemorate the discovery of America by Columbus. As it was to take place in the temperate zone, the summer was the proper season for it. The definitive site was determined at so late a day that the time afforded for preparation was unavoidably very short. Such considerations as these justified the postponement of its opening from October, 1892, the true quadri-centennial, to May, 1893. Six months more were afforded for the construction work, and the only possible time for it, the summer season, became available.

Seventeen years have elapsed since the United States, by a World's Fair, celebrated the centennial of their independence. The original exhibition of the character of a World's Fair was held in England in 1851, under the auspices of the Prince Consort of Great Britain. After exhausting its superfluous energies during centuries in international war, the world made an effort to establish an international contest in the arts of peace, and succeeded. The Crystal Palace, of London, a building unique in construction, and in many processes used in its erection, fittingly marked an epoch in itself, irrespective of its contents. New York followed the example, and soon after had its own Crystal Palace in what is now known as Bryant Park.

World's Fairs have been frequent since the early days referred to. London, Paris, Vienna, Philadelphia, have successively surpassed previous efforts. But the crowning achievement in every sense is that established on the shores of the inland sea—Lake Michigan. In every respect the Chicago exposition surpasses anything which the world has seen.

The readers of our columns have learned of the new methods of construction employed. The very walls are covered and decorated in a peculiar way. The architectural features, striking and chaste, have their impressiveness increased by their gigantic size. The same element affects the superb groups of statuary employed upon the buildings. But not content with this much, the highest skill of the landscape artist has been invoked. The water front has been utilized to the fullest possible extent in introducing the beauties of lake scenery. A new city built upon the low shores of the lake made the Venetian character appropriate, and the beautiful canals of old Venice are reproduced by the side of the pre-eminently modern Chicago. The entire conception and production are unique.

A World's Fair has never been held in a country of so large a population as that of the United States. A quarter of a million of people were present at its opening. Even this number at first sight might seem disappointing, a fact which alone indicates the immensity of the enterprise. But Chicago after all is a center of population not greatly exceeding a million of souls. Philadelphia, but two hours distant from New York, represented in 1876 an available area inhabited by several times this number. As the season advances the great trunk lines will pour thousands of visitors from all parts of the world into the metropolis of the lakes, and the White City will be adequately tenanted day by day.

Every world's fair has surpassed its predecessor. Such is the rule of existence of these institutions. Yet so immense is the Chicago Exposition, so utterly unprecedented in every respect, that it is hard to believe that it will be excelled in magnitude or beauty for many years to come.

The benefits direct and indirect to Chicago and to the West cannot well be overestimated. Even to-day the most curious misinformation as to the United States obtains in Europe. The present occasion will be a true revelation of an unknown civilization to many visitors to our shores, who do not realize that a city almost as large as Berlin has within the span of a lifetime grown up at the foot of Lake Michigan, nearly a thousand miles from the nearest sea port.

In this sense the Exposition will not be confined to the area, large as it is, of Jackson Park. The preliminary sight of New York City and the thousand mile ride through the Empire and Lake States, or over the Allegheny Mountains and across Pennsylvania and Ohio, teeming with industry of all kinds, will be the most impressive part for many. Over this ground the work of the past century is depicted. After lying almost inanimate for three hundred years' the discovery of Columbus took effect and awakened to life. It is only the last hundred years which have made the Columbian Exposition possible.

We have in preparation an extensive series of illustrations of notable objects pertaining to the Exposition, publication of which will soon be commenced. It will of course be impossible for us to illustrate all of the wonders gathered at Chicago; but we hope to place before our readers the pictorial forms of many of the most interesting things, and to present a general idea of the greatness and nature of this, the most recent and most remarkable assemblage of modern productions of science and the industrial arts.

THE WORLD'S COLUMBIAN EXPOSITION.

The World's Columbian Exposition is now a reality. It has been formally opened to the public, and although there had been more or less fear that the great claims made for it would not be realized, the results are even greater and finer than could have been anticipated. Chicago has fully demonstrated that she is competent to conceive, in all its details, the scheme of by far the greatest exposition ever undertaken; that she can carry it to consummation on a much broader scale than was first conceived. Not only has Chicago accomplished this, but she has paid out of her own coffers the chief cost of this vast undertaking. She has completed her part of the work in twenty-one months, and she has handled over 250,000 people on the opening day without difficulty. Such an achievement is stupendous; it is even beyond the conception of those who have witnessed the progress of the work.

A dreary sandy waste and swamp of 700 acres has been converted into a veritable city, the "White City," as it is called. The land has been transformed into a most artistic and beautiful park. It has been provided with a system of drainage designed on the latest improved scientific principles. Water, gas and electricity are supplied in almost unlimited quantities in all parts of the grounds, while compressed air is furnished in nearly all the larger buildings. The electric lighting plant, both arc and incandescent, has nearly twice the capacity of all the central lighting stations combined in the city of Boston. Practically 400 buildings have been planned and constructed, the aggregate floor area of these buildings reaching about 200 acres. These are some of the things that have been conceived and carried out in this remarkably short space of time.

There are things in connection with the Exposition that can be criticised. It is the fruit of human ability and effort. But there is so much that challenges admiration that the visitor, with any knowledge of what the Exposition is, how much has been accomplished, and under what difficulties work has been carried on, cannot fail to appreciate the great undertaking for what it really is. President Cleveland well said in his address at the opening exercises that we ask for no allowances on account of our youth. Neither the United States nor the Exposition need ask for such allowances. Every citizen should feel proud of the undertaking, and he who misses seeing it misses the crowning achievement of the century.

THE ELECTRIC SYSTEMS AT THE COLUMBIAN EXPOSITION.

One of the first exhibits ever made of an incandescent electric lighting plant in which the power to generate the electricity was furnished by steam was the one made at the Paris Exposition of 1878 by Mr. Edison. The engine and dynamo were practically one machine, the engine being probably the first one of high speed used for purposes of generating electricity. It was about this time that the incandescent lamp became a commercial success, and coincident with the accomplishment of this came the practical development and use of electricity. With the precedent of this plant it would be supposed that direct-connected plants would have become popular, especially as this particular plant was put into daily use in a light station at Milan and did excellent service.

Such high rates of speed were demanded that the matter of regulating the engine was a serious question to engine builders, and because of the greater success that attended the regulating of speed by belting down or up, the matter of direct connection was practically dropped in this country for many years. It has been carried to a point of much perfection in Europe, and is now fast coming into use in this country. Much larger units of power and of electrical energy are demanded each year, and while builders have been adding refinements to the wonderfully per-

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fect mechanism of the steam engine, dynamo builders have been building machines which do not require such high rates of speed as were formerly demanded, both because of improved design and construction as well as because of the increase in size.

The electric generating plants at the World's Columbian Exposition fully demonstrate the latest practice in this country in direct connecting. Six of the Westinghouse alternating current dynamos, each with a normal capacity of ten thousand incandescent lamps, will be direct-connected to Westinghouse compound engines of one thousand horse power each. Near by, in the power plant in the Palace of Mechanic Arts, the General Electric Company exhibits a vertical triple expansion engine direct-connected to two Edison multipolar power generators of five hundred horse power each. These two plants, each of which is of unusual capacity, demonstrate the adaptability of direct connection with vertical types of engines, while in the power house of the Intramural Railway is a direct-connected plant in which the engine is of the horizontal type. The engine in this case is a two thousand horse power cross compound Allis engine of the Corliss type, and the armature of a fifteen hundred kilowatt Thomson-Houston multipolar railway generator is built up on its shaft. With the claims for economy that are made for direct-connected plants, it would be instructive if these three installations were so arranged that they could be tested under different steam pressures, so as to ascertain the point of their highest economic working efficiency.

There are other direct-connected sets at the Exposition besides these mentioned. They are exhibits and not part of any plants in actual operation, but they all go to show that the plant designed and exhibited by Mr. Edison fifteen years ago was on the correct principle.

THE POST OFFICE OF THE COLUMBIAN EXPOSITION.

The model post office established in the World's Columbian Exposition grounds by the United States Post Office Department is now in full working order, and has been used since the middle of April. This office is a branch of the Chicago post office, but is known as the World's Fair Station, and all visitors at the Exposition who have no definite knowledge in advance as to what their address will be in Chicago may have their mail sent to this station by addressing it "World's Fair Station, Chicago." This office is situated in the southwestern corner of the United States Government building, and its general arrangement is in all respects highly convenient. At the extreme left is the private office of the superintendent of the station, then in consecutive order are windows as follows: Two "Carriers' Delivery" windows, two "General Delivery" windows, one "Registered Letters" window, one "Money Orders" window, one "Stamps Wholesale" window, one "Stamps Retail" window, and at the right hand corner an "Inquiry" window. Between the carriers' windows and the general delivery windows are about one hundred lock boxes which will be rented, but there are no call boxes. Near the right hand end are four slips for mailing letters, one each marked "North," "South," "East" and "West." Besides these there are slips marked "Packages," "Papers," "City" and "Foreign."

This office has about twenty-five postmen in the delivery service, and there are four deliveries of mail a day, mail being delivered at all the State buildings and foreign buildings as well as at the Exposition buildings. By this arrangement visitors from any particular State can, if they so choose, have their mail delivered at their State building, provided their State has a building. The service of this office, including the mail delivery, belongs equally to Midway Plaisance as to the Exposition grounds proper.

At the right of this post office is a model postal car with all its equipment complete. A full working model of this car, one-sixth in size, is also exhibited. In this connection the Post Office Department makes a complete exhibit of the various ways of carrying mails in addition to this postal car. There is a mail carrier on horseback with his equipment, a sled to which three dogs are harnessed, showing the manner in which mail is carried in the winter in extreme cold regions. There is also the Indian mail carrier on snow shoes, a "special delivery" boy on a bicycle, a fine model of the steamship City of Paris, also a model of the side wheel steamer Southern, of New York, the first steamer that ever carried the United States mails. There are also two wax figures of postmen in full uniform, together with a full and complete display of mail bags and pouches of all kinds, etc.

FOR BROWNING BLUE PRINTS.—Dissolve piece of caustic potash as big as a soup bean in 5 ounces of water. Place print in this solution, and it will fade to orange yellow. When all blue prints have disappeared, wash print thoroughly in clear water. Then dissolve a partly heaped teaspoonful of tannic acid in 8 ounces of water. Put the yellow prints in this bath, when they will turn to a brown that can be allowed to assume a tone of any required depth. Then wash well and dry.

THE OPENING ON MAY 1.

The World's Columbian Exposition was formally opened at noon on Monday, May 1.

From the day work was begun on the Exposition, the amount of energy expended has been almost limitless, and as the opening day drew near month by month, this amount of energy increased proportionately. The greatest amount of work was accomplished during the month of April, and especially during the last week or ten days, when from 15,000 to 17,000 men were employed, and work went on unceasingly. Exhibitors were given up to late Sunday night, the 30th day of April, in which to finish their work, or, if not finished, to have it reach as near as possible the point of completion. Meantime, while exhibitors were putting the finishing touches on their exhibits, from 4,000 to 5,000 men were cleaning up the grounds and buildings. These men worked through the night and up almost to the hour that the procession escorting the guests of the day entered the Exposition grounds, and they accomplished their work so that when the Exposition was formally opened to the world, it was ready for the inspection of visitors.

The ceremonies attending the opening began on Saturday, April 29, when the Duke of Veragua reached Chigago and was escorted to his hotel. An hour later President Cleveland with his cabinet and other government officials arrived and was escorted to the hotel by State and national troops, and a little later the Liberty bell, which received such ovations all along the route from Philadelphia, was escorted through the streets of Chicago to the Exposition grounds, received almost as great an ovation as was accorded the President and the descendant of Columbus. Thousands of strangers were in the city, and the streets were crowded from the station to the Exposition grounds, eight miles away. Public and private buildings were freely decorated, and, in spite of the gloomy weather, the ovation was a royal one.

Sunday, the 30th of April, was one of the most uncomfortable days that has been experienced in Chicago this spring. The atmosphere was chilly and a driving rain continued from early in the morning until after noon. Monday morning of the opening day, May 1, was somewhat brighter, and, although it was by no means pleasant, the sun made several brief appearances. The preceding week had been one of almost continuous heavy rains, and, as a consequence, the Exposition grounds and some of the streets were in bad condition. Many of the walks and promenades in the northern half of the Exposition grounds had had the finishing touches put upon them and had been rolled and swept until they were as hard and clean as an asphalt pavement. The highways of the southern end of the grounds—and it is here that the crowds largely center—had not been fully completed. Most of them had reached the point where only the top dressing and a little more rolling was required to complete them when the rains came and, lasting so many days, prevented the completion of the work.

The hour for opening the gates of the Exposition to the visitor is eight o'clock, but long before that hour on the opening day visitors poured in at all of the gates, and the stream increased in volume up to the time of the arrival of the procession. This procession consisted of a platoon of mounted park policemen, a detachment of city policemen, mounted, Company B Seventh United States Cavalry, the Chicago Hussars, mounted, Troop A Illinois National Guard, and a large number of carriages containing the officials of the Exposition, with the presidential and ducal parties, foreign representatives, city and State officials, ladies of the several parties, etc. This procession proceeded up Michigan Avenue, out the Boulevard, and entered the Exposition grounds by passing through Midway Plaisance. People crowded the streets along the entire route of the procession. In the Midway Plaisance the people in the several foreign villages turned out *en masse* to extend their welcome to the President. Turks, Moors, Egyptians, Singalese, Algerians, Japanese, Javanese, and the other foreigners extended their greetings to the President each in their own peculiar manner. Passing through the Plaisance into the Exposition grounds proper, the procession wended its way through throngs of people to the Administration building. Here the military companies formed an open passageway, through which the carriages passed as they drove up to the building, and the invited guests alighted.

The ceremonies attending the formal opening of the Exposition began promptly at half past eleven. The special platform constructed for the occasion on the east front of the Administration building provided sufficient seating capacity for the two thousand or more invited guests, the orchestra, the large chorus, and others. Exposition officials estimated that at least 150,000 people could be comfortably crowded into the Grand Plaza in front of the platform. Long before President Cleveland made his appearance on the stand all available space, not only in front but on each side of the Administration building and the great open areas in front of the Manufactures and Liberal Arts building and the Agricultural building, was crowded to the utmost, and thousands of people filled the grounds even as far east as in front of the Peristyle. The sight from the platform was magnificent. A large sounding board had been constructed directly back of the orchestra and chorus, and its efficiency was complete, thus adding much to the perfectness of the ceremonies.

After the President and other guests were seated, the ceremonies opened by the orchestra rendering the "Columbian March and Hymn." Dr. Milburn, chaplain of Congress, offered prayer, Miss Jessie Couthoui recited the "Prophecy," a poem written for the occasion by W. D. Croffut. Following the rendering of the overture, "Rienzi," by the orchestra, Director-General Davis of the Exposition delivered a short address, reviewing concisely the work and purpose of the Exposition. Concluding this address, the Director-General turned to President Cleveland, who returned the salute of the Director-General. As the President rose to his feet he was greeted by an outburst of cheering from the immense crowds in front of him, aggregating perhaps 300,000 people. Cheer after cheer arose, echoing from the Administration building across the basin to the Peristyle and back again. The President presented the purposes of the Exposition, asking for no allowance on the score of the youth of the nation, then declared the Exposition opened, and, touching the electric key, turned on the steam to the great 2,000 horse power engine of the power plant in the Palace of Mechanic Arts.

As President Cleveland touched the key and declared the Exposition opened, the sight and the sound following was most memorable. On every building throughout the grounds, and especially on those adjoining the basin and canals, the hundreds of flagstaffs had been arranged with their flags tightly furled but ready to be flung to the breeze at an instant's notice. Immediately in front of the grand stand were three poles, each eighty feet high, and on top of each was a golden model of the Santa Maria. At the signal, flags were unfurled from these poles and the halliards controlling the flags on every one of the other flag poles were loosened as if by one movement, and the flags of every country exhibiting at the Exposition, the Exposition colors, and an immense amount of bunting of bright and harmonious colors were flung to the breeze. At the same instant two electric fountains situated on either side of the McMonnies fountain, and immediately in front of the grand stand, sent great streams of water fifty to seventy-five feet in the air, and the great golden Statue of the Republic mounted immediately in front of the Columbus entrance to the Peristyle was unveiled. The man-of-war Michigan which lay immediately off the Exposition pier fired twenty-one guns as a Presidential salute. The steam launches in the basin blew their whistles, and at the same time whistles from steamers lying at the pier and the great steam whistles and gongs on the power plant of the Exposition joined in the din. The orchestra and the chorus closed the formal exercises with the tune "America," and at the second verse the whole concourse of people, guests and visitors joined in the singing.

President Cleveland and the other invited guests retired to the Administration building, where a lunch was served. While they were preparing for the lunch a band of several American Indians that had been stoically watching the exercises was led into the rotunda under the vast dome of the building, and at a given signal they sounded the Indian war whoop which startled the foreign guests. After a short rest following the lunch, the President, the Duke and a few more of the more prominent guests were escorted about the grounds and through the several buildings, riding part of the way in carriages and the rest of the way in electric launches on the waterways. Quite a little reception was held in the Manufactures and Liberal Arts building, where the President and the official representatives of all the exhibiting nations and colonies who were present were formally introduced. President Cleveland and party left the grounds at half past five for Washington.

It is hardly to be expected that such an enormous undertaking as this Exposition has been could be wholly complete in every respect on the opening day. Nevertheless visitors have no reason to be disappointed or critical, for on the opening day there were more exhibits to be seen and studied than any human being

(*Continued on page 294.*)

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ELECTRIC FURNACES.

The elegant experiments of Mr. H. Moissan have particularly attracted the attention of chemists and physicists to the important results that can be obtained by the use of the elevated temperature of the voltaic arc. The electric furnace employed by Mr. Moissan we have already described. This eminent chemist, in collaboration with Mr. J. Violle, has recently presented to the Academy of Sciences a note in which he furnishes some new information. Messrs. Moissan and Violle presented to the academy two models of electric furnaces. The first, which is analogous to the one we have already described, is adapted to the fusion of refractory metals, such as chromium and manganese. The second is designed for calorimetric researches serving to establish the temperature of the arc. We represent this furnace (Fig. 2) above the calorimeter. The bottom of the jacket of the furnace consists of a movable plate, after the manner of a slide. At the positive pole there is a fragment of carbon held by a rod of the same substance sliding by slight friction in a tube of carbon. One has only to give the rod a pull at the proper moment in order to cause the fall into the calorimeter of the fragment converted into graphite that has reached the desired temperature. No. 2 of Fig. 2 gives a view of the electric furnace with the piece of carbon that is detaching itself therefrom to fall into the calorimeter. The figure to the left (No. 1) shows the details of the carbon and of the receiver of the calorimeter.

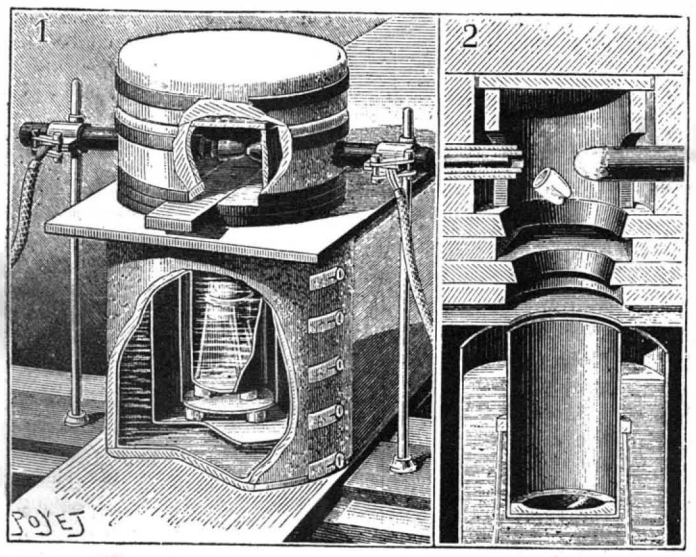


Fig. 2.—MOISSAN AND VIOLLE'S ELECTRIC FURNACE.

1. Furnace placed upon its calorimeter. 2. The carbon falling into the calorimeter.

The temperatures produced by these electric furnaces are the highest that can be obtained. They may vary under the following circumstances:

The temperatures obtained, says Mr. Moissan, naturally vary according to the duration of the experiment, and also according to the size of the furnace. They have no other limits than those of the voltaic arc. The more the calorific field is limited, the closer we shall approach the temperature indicated by one of us as being the calorific maximum that the arc is capable of producing. Practically, we obtain in our apparatus temperatures above 3,000° without any trouble.

These furnaces were constructed at the physical laboratory of the Normal School by Mr. Nion, superintendent of the workshop.

We shall now make known another model of electric furnace that any one may procure. It is constructed by Messrs. Ducretet and Lejeune. This apparatus was presented to the Academy of Sciences March 20, 1893, under the name of the electric crucible, and was devised for laboratory researches and assays. It is shown in Fig. 1.

The crucible, C R, of refractory material, receives two carbons, C and C', inclined at an angle of about 90°, and which are capable of sliding in special supports that permit of bringing them into contact or of separating them. The apparatus as a whole is inclosed in a metallic frame fixed to the base, K. The front and back faces are closed by plates of mica with joints of asbestos cardboard. The phenomena of fusion or reduction may thus be observed and a spectral analysis be made of them.

Through this arrangement we obtain a completely closed chamber in which the reactions take place without contact with the air and in the presence of certain gases. Two lateral tubes, as may be seen in the figure, serve for the circulation of the gases. An opening above closed by a cover, Bo, permits of the introduction into the crucible of the substances to be submitted to electrothermic action. The current is led by the two terminals, A B, whose wires in circuit may be seen in the figure.

The arc formed between the two carbons, says Mr. Ducretet, is converted at a distance into an elongated flame, forming a true electric blowpipe in consequence of the directing action of a magnet, Ai, placed near the apparatus. The arc may thus be directed upon the material contained in the crucible and be gradually brought to the maximum temperature. This arrangement, devised by us, is a new application of a known phenomenon already utilized by Jamin in his electric lamp. The model that we present to the academy is capable, with carbons of proper diameter, of supporting a current of 40 amperes. With a current of 12 amperes and 60 volts, it is possible to obtain the reduction of oxides and the fusion of the most refractory metals in quantities more than sufficient for their chemical or spectral analysis.

All the classical experiments and laboratory assays that require an elevated temperature can be carried out with this apparatus.—*La Nature.*

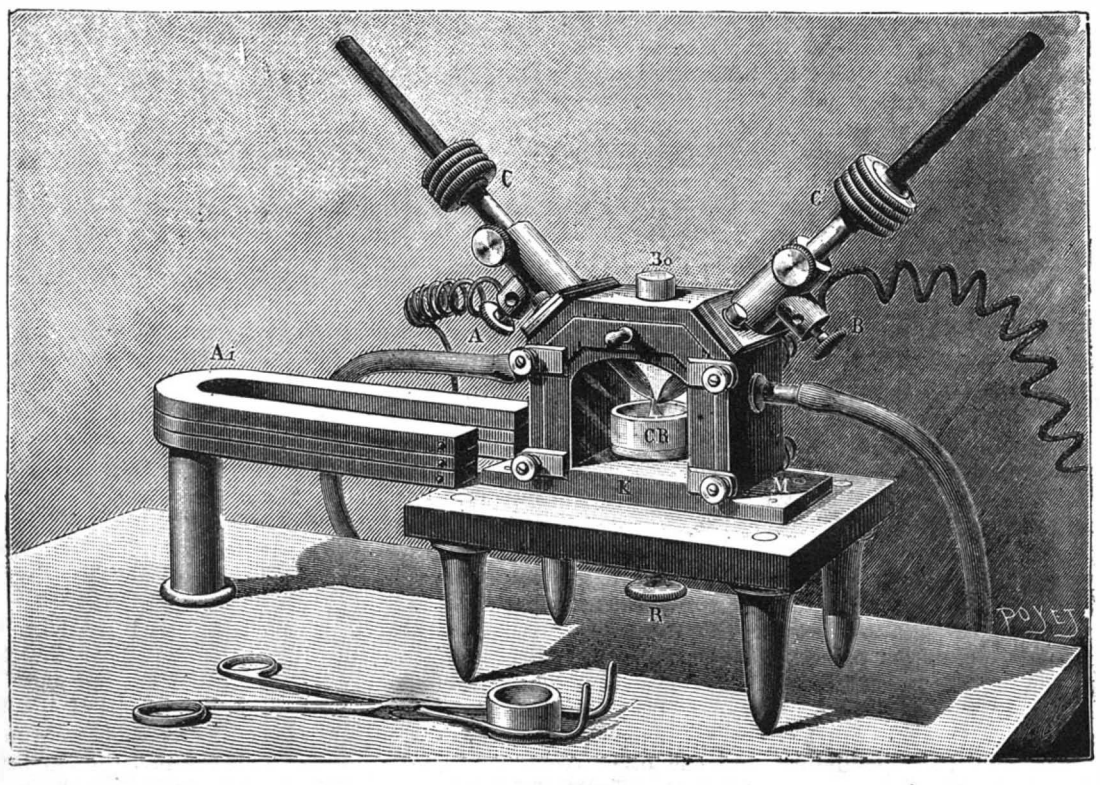


Fig. 1.—DUCRETET'S ELECTRIC CRUCIBLE.

Irrigation in Arizona.

Chief Engineer B. S. Church, of the New York water works, who built the celebrated Croton aqueduct, and who was at the head of the Croton water department, has been for some time consulting engineer in the building of great canals and reservoirs by the South Gila Canal Company, sixty miles east of Yuma, on the Gila. He says the engineering work has been completed, and the contract for constructing the canals and reservoirs has just been let to a Mr. Earland, of Los Angeles.

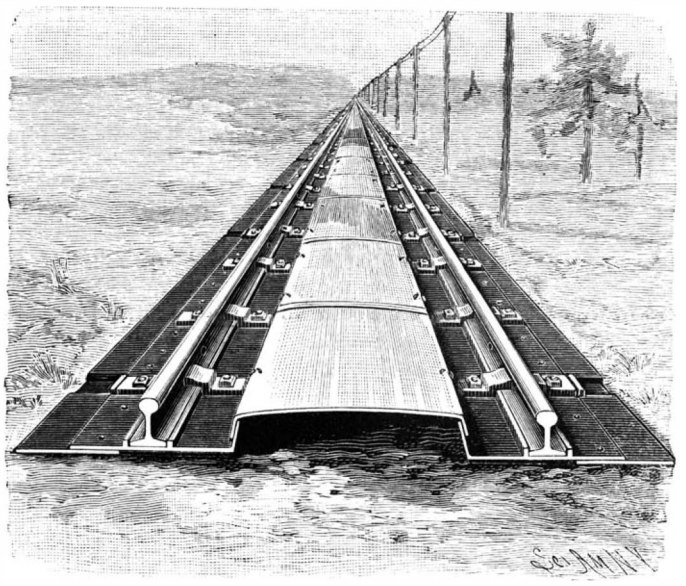
"The canal and reservoirs will, on the start," he said, "irrigate in the neighborhood of 300,000 acres, and the system may be extended to include more than 1,000,000. The canal system, it is expected, will cost $2,000,000. It is a very extensive system; will bring an immense tract of what is now arid land under cultivation, and will do much for Arizona.

"There is to be a canal with a levee, reservoirs and jetties, the jetties forming a series of lakes for fourteen miles, which give storage, and enable the projectors to overcome engineering difficulties. The diverting dam will be of masonry and earthwork, and probably be 50 feet high and 1,400 feet long. It will direct the water into the chain of lakes.

"Beyond the chain of lakes it is smooth going. There are no natural obstacles. The canal will probably be fifty feet wide, and carry eight feet of water."—*Pacific Lumberman.*

AN IMPROVED RAILWAY ROADBED.

In the roadbed shown in the accompanying illustration there is no wood to rot, the ordinary ballasting is not requisite, grass and weeds do not grow along the tracks, cattle will not travel upon it, and the spreading of the rails is made impossible. A metallic covering laid in sections, with movable water tight joints, covers the central portion of the roadbed, this covering being tied by wire fastenings at each side to side flanges upon metallic longitudinal sills, the latter having in their top surface rolled ribs between which is received the bottom of the rail. On the bottom of the sill, near its outer edge, is riveted a strip of lighter metal, widening the track base, this strip having depressions to receive the ends of the metallic crossties. The tie has a shoulder at each outer end, against which the outer edge of the sill rests, and the rail is held in place by cleats clamping the base of the rail to the sill and crosstie by means of bolts and nuts. With this improvement, after the grading has been completed, it is designed that the passing of a heavy roller over the ground shall afford sufficient preparation of the roadbed, without the ordinary ballasting of stone, etc. The crossties are first embedded in the ground, the sills and outer strip placed in position, and the earth tamped between the flanges on the inner edges of the strips, after which the rails and cleats are fastened in place, the central covering being laid last.



KAUFMAN'S METALLIC RAILWAY TRACK.

Further information relative to this improvement may be obtained of Mr. Daniel Kaufman, Boiling Springs, Pa.

Life Insurance.

However desirable a good physical condition together with a good family record may be in an insurance sense, unless you add to that a well-balanced mind and good habits you do not have a first class risk.

No matter how perfect the family history or how sound the physical condition, unless a man has good habits he will not prove to be a good risk. On the other hand, suppose the applicant is not in the enjoyment of vigorous health, but has a good family record, if that man is of temperate habits, is not guilty of many excesses of any kind, if he is disposed to take care of his health and give his system a chance to recuperate from any lost energy from overwork or any accidental exposure, or error in diet, that man, as a rule, is a better risk than the man of remarkable vigor but inclined to dissipation.—*The Guardian.*

Steel Barrels.

The manufacture has been commenced, at Barrow, of steel barrels for the carriage of petroleum in the place of wooden casks. The barrels are made in halves by means of dies and compression while the thin plates of steel are hot. These halves are welded together by means of electricity, and the barrels, when produced, are to be used in the petroleum trade in hot climates. The new process is one possessing great interest, not only to those engaged in steel manufacture, but to those engaged in the shipping trade, and particularly the bulk petroleum trade.

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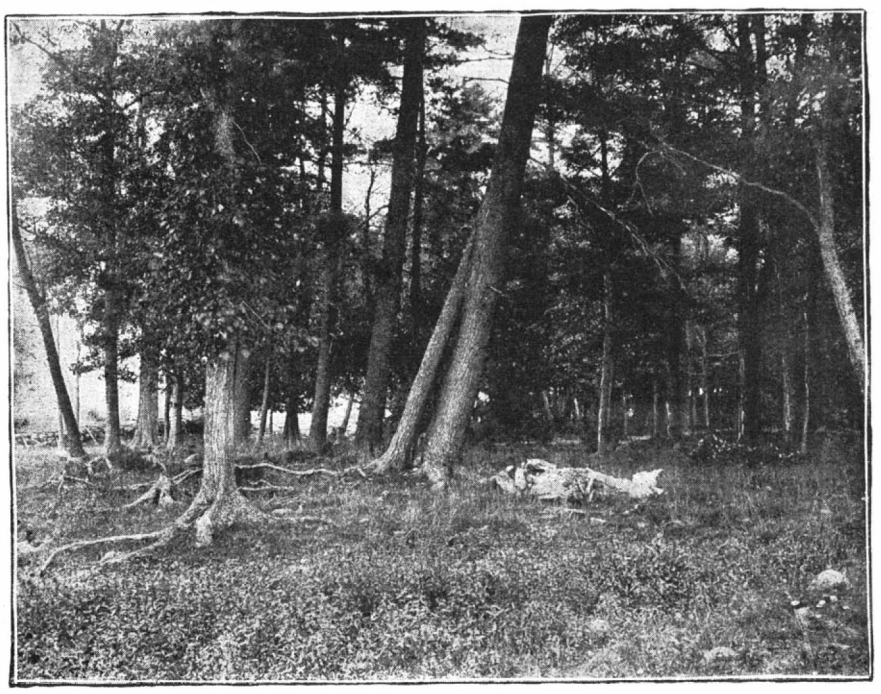
CURIOUS TREE GROWTHS.

To the Editor of the Scientific American:

I inclose a print made from a negative taken not long ago on my father's farm in eastern New York. I don't know that there is anything strikingly unusual, but how the two trees in the center ever became merged into one has been a mystery to me. One part appears much larger than the other. The tree, or trees, is of second growth white pine, and growing from between the two parts is a yellow birch, though, as it grows out on the opposite side from that represented, it does not show in the photograph. Having noted with interest accounts and explanations of various natural phenomena in your paper, I have thought for some time of sending you a copy of this view. The tree stands in the corner of a wood on the farm of W. J. Morey, in Saratoga, N. Y.

Kearney, Neb. J. T. MOREY.



CURIOUS TREE GROWTHS.

American Boys and American Labor.

Shall American boys be permitted to learn trades, and, having learned them, shall they be permitted to work at them? These are apparently simple questions, and the answering of them is an apparently simple matter. Most persons thus interrogated would reply at once: "Certainly they should. Why do you ask such unneccessary questions?" We ask them because under the present conditions of trade instruction and employment in this country the American boy has no rights which organized labor is bound to respect. He is denied instruction as an apprentice, and if he be taught his trade in a trade school, he is refused admission to nearly all the trades unions, and is boycotted if he attempts to work as a non-union man. The questions of his character and skill enter into the matter only to discriminate against him. All the trades unions of the country are controlled by foreigners, who comprise the great majority of their members. While they refuse admission to the trained American boy, they admit all foreign applicants with little or no regard to their training or skill. In fact, the doors of organized labor in America, which are closed and barred against American boys, swing open, wide and free, to all foreign comers. Labor in free America is free to all save the sons of Americans. These are neither idle nor exaggerated statements. They are sober, solemn truths, expressed in studied moderation. So-called American labor to-day is a complete misnomer, as far as the trades are concerned. How has it come about that the United States, alone among the nations of the earth, has not merely surrendered possession of her field of mechanical labor to foreigners, but acquiesces when the foreign possessors exclude from that field her own sons?

The *Century* has been so strongly impressed with the evils of this anomalous situation, so unjust to American boys and so fraught with danger to the national welfare, that it has instituted a thorough inquiry into the causes which have produced it. The results of this inquiry will be set forth in subsequent articles, each devoted to a particular phase of the question. It will be shown that the two great causes have been the passing away of the old apprentice system and the enormous emigration to this country from all parts of Europe. It will be shown that all the trades unions of this country are controlled by men of foreign birth; that nearly all of them have such rules against the employing of apprentices that American boys can no longer, in any of the large cities of the country, learn a trade by working in shops with journeymen; that such boys as learn trades in trade schools are refused admission to the unions, not because they are not well taught, but because they have not served apprenticeship according to union rules, and are boycotted and persecuted if they attempt to work as non-union men.

It will be shown also that while all the unions combine in this effective conspiracy against American boys, they admit freely to their organizations foreign workmen who have not served full apprenticeships, and who have only a slight knowledge of their crafts, and instruct them to a fuller knowledge while obtaining for them full pay as journeymen. It will be shown also that the bulk of foreign laborers who come to America are the poorest of their trades in Europe, the best workmen always finding abundant work and satisfactory pay at home; that in addition to being indifferent workmen, they are in many instances men of inferior moral training and instincts, frequently of turbulent and anti-social proclivities and practices, and are often without sympathy for American institutions, and have no regard whatever for the country's welfare. It will be shown also that in addition to the foreign laborers who take up their abode here and possess the field, there are many thousands of others who come here in every busy season, work while that season lasts, and return to their homes when it is ended. It will be shown that while these "harvesters," as they are called, are admitted to the unions and are given work on equal terms with union members, the union authorities refuse American boys as apprentices and journeymen on the ground that the labor market is crowded, and the interests of labor will be harmed if Americans are allowed to come in.

In the earlier days of the republic the American mechanic was everywhere known as one of the sturdiest representatives of American character. He was an honest man, a good workman, a loyal, faithful citizen. To-day he is an almost extinct species. As a nation we lead the world in mechanical skill, yet we are the only nation in the world that has almost ceased to produce its own mechanics. We not only take the great mass of ours from other countries, but we accept their poorest specimens, and having accepted them, we allow them to control the field against our own sons. The consequences of this policy, already momentous, are destined to become more so as time advances. We are not only bringing up our sons in idleness, not only depriving our experiment in popular government of the invaluable support of a great body of conservative citizens of American birth, but we are accepting in place of such a body one that is composed of and controlled by men of foreign birth, whose instincts and character are not merely un-American, but oftentimes anti-American. This body, acting frequently as a unit throughout the country, is able to paralyze all business and industry, and to bring the nation itself almost to the brink of social revolution and industrial war. Is it not time that Americans began to think seriously of these things? Have not the developments of the past few years in the so-called conflicts between capital and labor been portentous enough to give pause to all patriotic Americans? Could anything else have been reasonably expected from a policy which is so full of injustice to our own countrymen, and consequently so humiliating to us as a people? Is there any remedy save in a reversal of that policy?—*The Century Magazine for May.*

"STRIP, THE ELECTRICIAN."

A Brighton correspondent of the London *Daily Graphic* sends the accompanying sketch of "Strip, the Electrician," the clever fox terrier belonging to Messrs. Crompton, the electrical engineers, preparing to go to work underground. Strip's business is to carry each electric light wire through the pipe to the workmen waiting at the other end, who disengage it from her collar, to which the wire is fastened before she starts. The dog then scrambles through the pipe with the utmost vigor, and seems to understand perfectly what her business is, and does it without any delay. Before going to Brighton, Strip did good work for her employers in London, where she laid down many miles of electric light wire.

"STRIP" THE ELECTRICAL TERRIER.

The Stone Age in Tasmania.

At a recent meeting of the Anthropological Institute, Dr. E. B. Tylor, F.R.S., exhibited a collection of the rude stone implements of the Tasmanians, showing them to belong to the palæolithic or unground stage of the implement makers' art, below that found among prehistoric tribes of the mammoth period in Europe, and being on the whole the lowest known in the world. Fragments or rough flakes of chert or mudstone, never edged by grinding, but only by chipping on one surface with another stone, and grasped in the hand without any handle, served the simple purposes of notching trees for climbing, cutting up game, and scraping spears and clubs.

The Tasmanians seemed to have kept up this rudimentary art in their remote corner of the world until the present century, and their state of civilization thus became a guide by which to judge of that of the prehistoric Drift and Cave men, whose life in England and France depended on similar though better implements. The Tasmanians, though perhaps in arts the rudest of savages, were at most only a stage below other savages, and did not disclose any depths of brutality. The usual moral and social rules prevailed among them, their language was efficient and even copious, they had a well marked religion in which the spirits of ancestors were looked to for help in trouble, and the echo was called the "talking shadow."

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THE OPENING ON MAY 1.

(*Continued from page 291.*)

could comprehend or appreciate in several weeks of time.

Brief History.—A brief review of the history of the Exposition, its conception and consummation, will give some idea of the immense amount of work that has been accomplished. The act of Congress under which the Exposition was organized bears date of April 25, 1890. Several months following were consumed in discussing and arranging the organization of the World's Columbian Exposition Corporation, which was organized under the State laws of Illinois. Then came the question of selecting a site, and when Jackson Park was finally decided upon, it was necessary to do an immense amount of preliminary work before the foundation of a single building could be laid. Up to this time Jackson Park was a large tract of wild land with a few drives and walks in it, but mostly a swamp which at certain periods of the year was inundated by Lake Michigan. This tract comprises about 700 acres and was put into the hands of landscape engineers who, after an immense amount of dredging and leveling, evolved the present grounds. Ground was first broken July 2, 1891. Since then about 400 separate and distinct buildings have been erected, exclusive of booths, pavilions and other such buildings for concessionaires. All but about 50 of these are Exposition buildings, and it is estimated that the entire 400 buildings give 200 acres of floor space. It will thus be seen that in less than 21 months all these buildings have been designed and constructed, and many of them filled with exhibits. These buildings vary in size from small structures of one or two little rooms to the great Manufactures and Liberal Arts building, which is about a third of a mile long and a quarter of a mile wide. Throughout the buildings there are over 30,000 exhibits, representing 50 countries and 37 colonies. Seventeen foreign nations have constructed buildings, and there are nearly forty State buildings erected by the different States of the United States. The buildings, as a rule, are of a cream white tone, and with a few exceptions color effects are given by the use of bunting, of which over 100,000 yards have been used for furnishing flags and colors for the Exposition buildings alone.

The Attendance on the First Day.—The estimated attendance on the opening day shows that over a quarter of a million people were inside the Exposition grounds, of which 150,000 paid admission fees, and the fact that this vast multitude was handled on the opening day without excessive crowding or jamming proves that the transportation facilities are equal to almost any probable demands that may be made upon them.

Opening of the Woman's Building.—Next to the opening of the Exposition itself, the most interesting exercises were the dedication of the Woman's building, which took place two hours after President Cleveland had declared the Exposition open. The exercises were held in the Hall of Honor in the Woman's building, and a large number of distinguished women from various foreign countries and various parts of the United States were present. The exercises consisted of music, prayer, the reading of an ode written by Miss Flora Wilkinson. Mrs. Potter Palmer, President of the Board of Lady Managers, gave an address explaining what had been accomplished. A jubilate, written especially for the occasion by Mrs. H. H. A. Beach, of Boston, was sung, and several of the ladies on the platform, especially those representing foreign countries, made addresses. The event of the exercises was the driving of the golden nail by Mrs. Palmer. This was the last nail driven, and was the formal act of declaring the building complete.

The Michigan, Massachusetts, New York, Missouri, Swedish and many other buildings were formally opened for the entertainment of visitors.

Early in the evening, before the time for closing the grounds to visitors arrived, the electric lighting equipment of the Administration building was tested, and every lamp, both arc and incandescent, was used. The effect was in every way perfect.

In every way the opening of the Exposition was remarkably auspicious. The Exposition buildings themselves, with the exception of one or two of the minor buildings, were complete, and the work of installing exhibits was in a very forward state. Outside of the Palace of Mechanic Arts fully eighty per cent, if not more, of the exhibits were ready for the inspection of visitors Monday noon.

The Stage Coaches.—A new method of transportation to the Exposition grounds from the heart of Chicago was inaugurated only a few days before the Exposition opened. This is a line of coaches which will be in many respects a reproduction of the balmy days of stage coaching in the far West. The coaches will have a seating capacity for perhaps twenty-four people on top and sixteen inside, the coaches being modeled after a style of coaches used at the Paris Exposition. The horses are of American breed, having come from the West, and most of them being stage coach horses. The drivers are experts from the West who are in the habit of driving something after the manner of Horace Greeley's stage coaching in Nevada, but whatever the speed may be the riding will be comfortable, as the coaches will start from the center of the city and go to the Exposition grounds over the boulevard system of the city. The ride will consume about an hour. There will probably be six horses attached to each coach.

Drilling the Ticket Takers.—The men having charge of handling tickets at the sixteen or more entrances to the Exposition grounds were put through a course of training for several days before the Exposition was formally opened, and it was rather an amusing sight to see the rows of dummy visitors going in and out of the several gates in order that the training should be a literal reproduction of the conditions soon to come. Nearly five hundred ticket sellers were engaged. These men were divided up into sections, as there will be three shifts of men to work during the hours which the Exposition is open, each shift working six hours at the gate and having an allowance of one hour for squaring accounts. Each ticket seller is under bond for the satisfactory performance of his duties. The gates are open to the public at eight o'clock in the morning, and visitors are supposed to be out of the grounds by half past six in the evening, and when there are evening sessions from eight until half past ten. The Exposition management has aimed to give ample facilities at the several gates for selling tickets as rapidly as visitors can be admitted to the grounds, but it is urged that visitors take advantage of the many ticket stations away from the grounds, at the railroad stations, hotels and elsewhere, so that there shall be as little delay as possible in securing admittance.

Several hundreds of aquatic birds of many varieties have been put into the lagoon. One wing of each bird is crippled, so that none of the birds can fly. Most of these birds are those that are native to the Chicago climate. Their presence adds much to the picturesqueness and life of the scene surrounding the lagoon. What adds still more naturalness to these banks is the fact that thousands of plants indigenous to the swamps and waterways of Illinois have been transplanted to these waters, and especially to the shores of the Wooded Island. The size and vigor of these plants gave every appearance to the island last fall of their having always been there, while the fact is nearly every individual one had been transplanted within twelve months. This fringe of green will give enough natural tangle to the shore of the island to obliterate every appearance of being artificial. Besides the Wooded Island there is the Hunter's Island, which immediately joins it on the south, and several other very small patches of green forming miniature islands, and these also have been transformed into a mass of green. The Wooded Island comprises about sixteen acres. Quite a little is cut off from the northern end, having been assigned to Japan for its floricultural exhibit, and also for the site of the Hooden, which is Japan's gift to the Park Commissioners of Chicago. But nearly ten acres of the area of the island are devoted to flowers. By far the most noticeable display will be the rose beds, which in themselves cover considerably over an acre. Most of the work on these beds was completed last fall. Thousands of full grown plants of the hardier types were set out, and these seem to have wintered with practically no loss by winter killing. Every variety of hardy roses is included in this display. Other roses in great variety, which could not live through the winter if exposed, were kept in the Horticultural building and were transplanted in time for the opening of the Exposition. At the southern end of the island is a splendid display of rhododendrons, and there are also scattered about the island, as well as throughout the grounds, clusters of the more well known shrubs, such as lilacs and azaleas. There are something like 25,000 or 30,000 hardy plants in the rose garden, and more than half as many of the tender kinds, which were wintered in the Horticultural building. In the center of the garden is a pavilion of considerable size, which will be a mass of green by June 1, because of the innumerable vines that climb over it. Many nurserymen throughout the country have contributed generously ornamental and flower shrubs. England has also made a fine display of typical English plants and the Germans have brought some of the favorite German plants. There have been planted on the Wooded Island and throughout the grounds over 12,000 trees, 5,000 shrubs, 15,000 miscellaneous plants, nearly as many aquatic and semi-aquatic plants, and several thousands each of fern roots, climbing vines, ornamental grasses, etc.

The idea of having two model American locomotives of the latest and most powerful type mounted on pedestals in front of the Railway Terminal Station was abandoned at the last minute. The effect was not quite so satisfactory as it was thought it would be, and one locomotive, which had already been put in place, was removed to the Transportation building.

The monster Krupp gun, which has been so fully illustrated and described in these columns, reached the Exposition grounds without mishap, and was mounted in place a week before the Exposition was opened. Nothing in the grounds in the shape of an exhibit has attracted much more attention, and the German workmen and Columbian guards at the Krupp building had their hands full in keeping people from crowding inside the structure. This was specially true at the noon half hour, when large squads of workmen, from all corners of the grounds, made a line for the Krupp building. The monster is so surrounded by smaller guns, castings, and other exhibits, that a picture of it as it now stands is rather unsatisfactory. As it rests on its carriage, the gun is pointing directly out over the lake. Cartridges which are used in firing are near by, and the apparatus used in handling the gun is shown, thus making the exhibit very complete.

LOCOMOTIVES OF 1831 AND 1893.

Among the exhibits at the Chicago World's Fair, in which are shown contrasts between past and present, none will more strikingly illustrate the progress made in the last sixty years than the exhibit of the New York Central and Hudson River Railroad, consisting of a reproduction of the De Witt Clinton locomotive, which was the first engine to draw a train in the State of New York, and the sixty-two ton passenger locomotive 999, of the New York Central and Hudson River Railroad, just turned out of the New York Central shops at West Albany.

The De Witt Clinton was built in New York City in 1831, at the West Point foundry, located at the foot of Beach Street. The engine had four drive wheels, 4 feet 6 inches in diameter; the cylinders, two in number, were 5½ inches in diameter by 16 inch stroke. The boiler had 30 copper tubes, 2½ inches in diameter; the engine weighed about 6 tons, and was provided with a tender carrying fuel and water. On the tender there was a seat for the conductor. The engine had a boiler feed pump driven from the crosshead, and also a hand feed pump. This engine drew a train of three coaches, made in the style of the old-fashioned stage coaches. Trial trips were made on the Mohawk and Hudson Railroad at various times from July 2 to August 9, 1831, when the first regular excursion trip was made. The passengers on this occasion were Erastus Corning, Mr. Lansing, Ex-Governor Yates, J. J. Boyd, Esq., Thurlow Weed, Esq., Mr. Van Zant, Billy Winne, penny postman, John Townsend, Esq., Major Meigs, Old Hays, high constable of New York, Mr. Dudley, Joseph Alexander, of the Commercial Bank, Lewis Benedict, Esq., and J. J. De Graft. David Matthews was engineer and John T. Clark was conductor. The signal for starting was given by blowing a tin horn. The fuel used on this trip was dry pitch pine, coal having proved unsatisfactory, and as there was no spark arrester on the stack, the smoke and sparks were freely poured on the passengers in the coaches. They raised their umbrellas to protect themselves, but the covers were soon burned off, and the passengers busied themselves in putting out in each other's clothes the fires started by the hot cinders. When stop was made at a water station, the slack between the coaches, which produced disagreeable jerks, was partly remedied by wedging rails from a neighboring fence between the cars and tying them fast. On arriving at Schenectady refreshments were served, after which the party returned to Albany, and thus was completed the first regular trip of a locomotive and train in New York State. The coaches which made up the train were built by James Goold, of Albany. The upper view in our engraving is taken from an old sketch, supposed to have been made on the occasion of this excursion. It graphically represents the effect of the first view of a locomotive and train.

The lower view in the illustration represents the De Witt Clinton as it stood in the New York Central passenger station alongside of engine 999, which represents the accumulation of knowledge, skill, and experience of over sixty years in locomotive engineering and building. Engine 999 is the latest and probably the finest locomotive in this country. It was designed by Mr. William Buchanan, superintendent of motive power of the New York Central and Hudson River Railroad, and was built at the shops of the company, at West Albany. The cylinders are 19 inches in diameter by 24 inches stroke. The drivers, of which there are four, are 7 feet 2 inches in diameter, and the tires are 3½ inches thick and 5¾ inches wide, secured to the cast iron centers by Mansell retaining rings, The truck wheels, which are 40 inches in diameter, are also provided with steel tires and Mansell retaining rings. The total wheel base is 23 feet 11 inches. The weight on the four driving wheels, loaded, is 84,000 pounds, and on the engine truck 40,000 pounds, making a total of 124,000 pounds. The boiler is of the wagon-top style, and the firebox is of the Buchanan type, with a water arch. It is 108 inches long and 40⅞ inches wide. The total heating surface is 1,930 square feet, with a grate surface of 30·7 square feet. The height of the engine at the center of the boiler is 8 feet 11½ inches above the rail.

The boiler is designed to carry 190 pounds working pressure to the square inch. The tender has a coal

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capacity of 6¾ tons, and carries 3,857 gallons of water, and is fitted with a water scoop. The weight of the tender loaded is 80,000 pounds. The engine is fitted with the Westinghouse air brake, and the engine and brake are fitted with the Westinghouse air signal. The locomotive was three months in building, and cost in the neighborhood of $12,000.

This new engine differs in outward appearance from those previously built. No brasswork is visible. The ironwork is well finished and polished. The pipes are nickel-plated and the painted portions are striped with silver leaf. A round headlight is mounted over the smokestack.

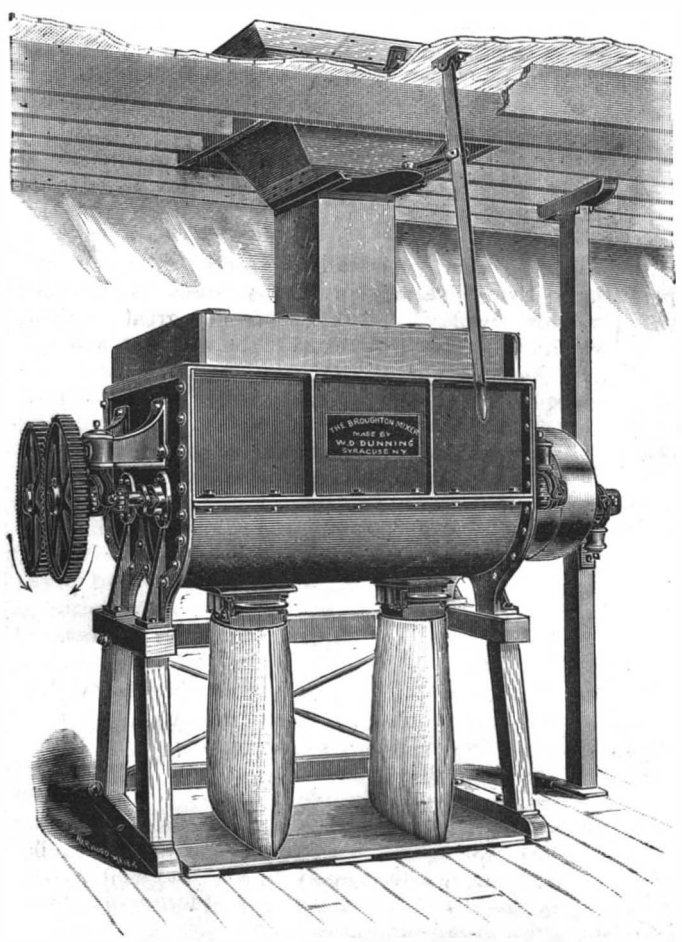
The main dimensions of the engine are tabulated below:

Cylinders	19 in. × 24 in.
Diameter of driving wheels outside of tires.	86 in.
Diameter of engine truck wheels	40 in.
Springs, length of driver, center to center of hangers	44 in.
Total length of boiler	26 ft. 4⅛ in.
Diameter of first ring outside	58 in.
Size of firebox	108¾ in. × 40⅞ in.
Tubes, 268	2 in. dia., 12 ft. long.
Heating surface in tubes	1,697·45 sq. ft.
Heating surface in firebox	232·92 sq. ft.
Total heating surface	1,930·37 sq. ft.
Grate surface	30·7 sq. ft.
Stack, inside diameter	15¼ in.
Weight, in working order	124,000 lb.
Weight, on drivers	84,000 lb.
Driving wheel base	8 ft. 6 in.
Weight of tender loaded	80,000 lb.
Total weight of engine and tender	204,000 lb.
Extreme length of engine	39 ft., 6¾ in.
Extreme height from top of rails to top of stack	14 ft., 10 in.

This engine is designed to draw the Empire State Express. On its way to the Chicago Exhibition it easily made a speed of 86¾ miles per hour, and the designers and builders believe that after it has worn enough to smooth up its bearings it will create a sensation in the matter of speed.

THE BROUGHTON QUICK DELIVERY MIXER.

A machine for thoroughly mixing hair and fiber with plaster, and one which can be easily taken care of and quickly set up and operated by any ordinary workman, is shown in the accompanying illustration. The machine is made by W. D. Dunning, of Syracuse, N. Y., and the design is the perfected result of a long experience and practical knowledge of what is required in a plaster mill. All the working parts and mixing chamber are of iron and steel, making the machine solid and durable. It has two shafts running horizontally side by side, geared to run in opposite directions; they are run through a cast iron case circling at the bottom, so that the paddles placed on the shaft in screw form lift the material from the bottom of the case and throw it in opposite directions from one end of the case to the other, thereby keeping it in constant motion and obtaining a perfect mixing. All bearings run in self-oiling boxes outside of the case, so that the material does not come in contact with them. The mixer is provided with two openings in front with slides or gates to let the material out of the machine, and to each of these openings is attached an automatic bag holder. The delivery is very rapid, the discharge from one opening being as fast as one man can take the bags away. The wooden hopper to receive charge passes through the floor above; attached is a cast iron slide arrangement to let material through the spout to mixing chamber, operated by means of a lever within reach of the operator on the ground floor. The machine is provided with two 24 × 8 fast and loose pulleys and should run 175 revolutions per minute; it requires about 4 × 6 feet floor space and has a capacity of 300 barrels per day of 10 hours.



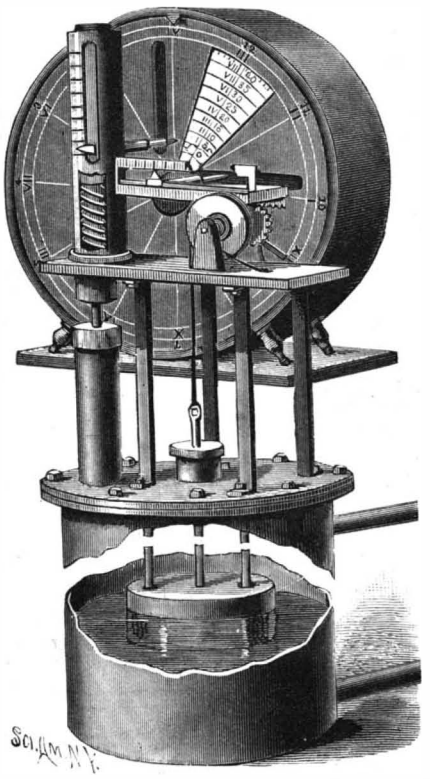
THE BROUGHTON QUICK DELIVERY MIXER.

The Conquests of Modern Science.

Surely I have established my thesis that dirt is only matter in a wrong place. Chemistry, like a thrifty housewife, economizes every scrap. The horse shoe nails dropped in the streets are carefully collected, and reappear as swords and guns. The main ingredient of the ink with which I now write was probably once the broken hoop of an old beer barrel. The chippings of the traveling tinker are mixed with the parings of horses' hoofs and the worst kinds of woolen rags, and these are worked up into an exquisite blue dye, which graces the dress of courtly dames. The dregs of port wine, carefully decanted by the toper, are taken in the morning as seidlitz powder to remove the effect of the debauch. The offal of the streets and the wastings of coal gas reappear carefully preserved in the lady's smelling bottle, or are used by her to flavor blanc-manges for her friends. All thrift of material is an imitation of the economy of nature, which allows no waste. Everything has its destined place in the process of the universe, in which there is not a blade of grass or even a microbe too much, if we possessed the knowledge to apply them to their fitting purposes.—*North American Review.*

A STEAM PRESSURE AND WATER LEVEL RECORDER.

With the device shown in the illustration a single steam gauge or water gauge for a boiler is not required, the steam pressure and the height of the water being indicated at sight, indicator diagrams being also furnished of both, by which the owner may see whether the boiler and the furnace fires have had proper attention.



LEWIS' STEAM PRESSURE AND WATER LEVEL RECORDER.

The improvement has been patented by Mr. William M. Lewis, of Thurber, Texas. At the front of the boiler is a closed vessel connected by pipes with the steam and water spaces, and having on its top a cylinder, in which is a piston with a rod extending upward in a casing on which graduations are marked. Around the upper end of the rod is a coiled spring, insuring a return movement of the piston with diminishing steam pressure, and the rod has in front a pointer indicating on the graduations, while from its rear a spring-pressed pencil extends through a slot in a clockwork casing. The dial, which is revolved by the clockwork, has near its outer edge a double graduation, one in Roman and the other in Arabic numerals, and a pointer fixed on the casing at the top indicates the time of day as the dial revolves. As the pointer indicates the steam pressure to the sight, the pencil marks a corresponding line on the moving dial. In the closed vessel at the front of the boiler is also a float, from which extends upwardly a rod connected with a belt passing over a wheel rotated by a spring, to correspond with the rise and fall of the float. On the shaft of this wheel is a gear meshing into a rack operating a horizontal slide, on the casing of which is a graduation, the rear portion of the slide also carrying a spring-pressed pencil traveling in a horizontal line on the dial. An indicator made in the shape of a sector corresponding to one of the divisions of the dial is hung loosely on the shaft of the latter, the indicator having two sets of graduations corresponding to those of the horizontal and vertical scales, one indicating the height of water in the boiler and the other the steam pressure. By placing this indicator in proper position on the dial, it will indicate the steam pressure and height of water in the boiler at any particular time. The dial is preferably of slate, so that the markings may be easily wiped off, and, by using different colored pencils, as red and blue, a red line may represent the steam pressure and a blue line the water level, or *vice versa*.

Rock Emery Millstones.

Probably few of our readers have ever seen rock emery, and fewer still have heard of millstones made of this hardest of all stones except the diamond. But rock emery millstones are now made, and a long step has thus been taken toward pulverizing cheaply many hard substances that have heretofore only been reduced at much expense of wear and tear, and by slow and tedious processes. Rock emery is not a common mineral, being found only in a few countries. The best comes from Greece, but the larger importations are from Turkish mines. The consumption of emery is large, and its use has become of great importance in many industries, as it easily grinds away all substances with unexampled rapidity. A pure emery face never glazes, but is always sharp and cutting.

Rock emery mills reduce at once the hardest rocks or the softer substances, grinding all to any degree of fineness. Heat does emery no harm, and one of the remarkable properties of the emery stones is their ability to run cool. They form the most rapid grinder known, and are as much more durable than other millstones as they surpass them in hardness. The emery millstone face is never dressed, a little work on the furrows, and eye (made of softer material), is all the sharpening it requires. These stones are made to take the place of all other millstones, without any changes in the mill, and wherever other stones are used the rock emery millstones will do better work at less expense, and last much longer. They also grind hard materials that soon destroy all softer millstones. The hardest buhr, compared with emery, is like cheese.

Now that the manufacture of the patent rock emery millstones is understood they are turned out for all sorts of mills and for all purposes, at a moderate price, and wherever known are recognized as wonderful grinders, especially for fine work, from 60 to 150 mesh. These rock emery millstones are ample proof, if any is needed, of the progress of American milling.

A Colored Man's Career.

Frederick Douglass, ex-minister to Haiti, has been negotiating with the owner for the purchase of the Villa, one of the most valuable and beautiful estates in Talbot County, Maryland. Mr. Douglass is a native of Talbot County, where he was born a slave. In addressing an audience at the colored school at Easton, Md., recently, Mr. Douglass said: "I once knew a little colored boy whose mother and father died when he was but six years old. He was a slave and had no one to care for him. He slept on a dirt floor in a hovel, and in cold weather would crawl into a meal bag head foremost and leave his feet in the ashes to keep them warm.

"That boy did not wear pants like you do, but a tow linen shirt. Schools were unknown to him, and he learned to spell from an old Webster's spelling book and to read and write from posters on cellar and barn doors, while boys and men would help him. He would then preach and speak, and soon became well known. He became presidential elector, United States marshal, United States recorder, United States diplomat, and accumulated some wealth. He wore broadcloth and didn't have to divide crumbs with the dogs under the table. That boy was Frederick Douglass.

"What was possible for me is possible for you. Don't think because you are colored you can't accomplish anything. Strive earnestly to add to your knowledge. So long as you remain in ignorance, so long will you fail to command the respect of your fellow men."

LETTER boxes have been attached to the street cars in Huddersfield, England, and letters can be posted in these boxes as the cars are traversing the suburbs, the boxes being emptied by the post office employes on the arrival of the car at or near the central post office on each trip. If a person stops the car especially for the purpose of mailing a letter, a penny is collected by the conductor and deposited in the fare box. This doubles the cost of sending the letter, but the advantage of an immediate special delivery is secured, and letters are greatly expedited by the scheme. The scheme is yet an experiment, but it is largely approved.

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EDISON'S IMPROVEMENT IN THE TRANSMISSION OF POWER.

The object of this invention, which is by Thomas A. Edison, is to produce a new mechanical movement by the aid of magnetism which will permit the positive transmission of large powers at high velocities without the excessive noise incident to the use of toothed gearing. In his patent he says: This I accomplish by the employment of smooth face iron pulleys or wheels which are made strongly magnetic by suitable windings connected in circuit with a suitable source of electrical energy, and by the use of endless belts, chains, or ropes which are either themselves magnetic, or carry iron bars (or both), which form armatures to close the magnetic circuits at the pulleys, and are strongly attracted to the faces of the pulleys so as to increase the adhesion and transmit the power without slip. Or, the magnetic bars, instead of being carried directly by the belts, chains or ropes, may be arranged in a frame over the belt, chain, or rope where it passes around the pulley, and be capable of a movement toward the pulley to a limited extent, so as to press the belt, chain or rope upon the pulley.

Referring particularly to Figs. 1, 2, and 3, A and B are two iron pulleys mounted upon parallel shafts and connected by an endless belt, C. Each of these pulleys is provided with several circumferential grooves, shown more particularly in Fig. 2, in which are located windings, *a*, of insulated wire, connected at the ends to insulated rings, *b*, upon which bear contact springs, *c*. These contact springs being connected with a suitable source of electrical energy, indicated by the circuit, 1, 2, each pulley becomes strongly magnetic, as indicated by the letters N, S, in Fig. 2, the circumferential ribs or exposed faces of the pulley on opposite sides of each of the windings being oppositely magnetized. The belt, C, is preferably constructed of a number of thin sheet steel strips placed one over the other as shown in Fig. 3, and upon the outside of these are secured, like the rounds of a ladder, cross bars, *d*, of soft iron which are riveted to the belt, the strips of steel being at the same time riveted together so as to form a continuous belt. The steel belt and the bars, *d*, bridge the windings of the two pulleys completing the magnetic circuits around the windings, thus forming armatures or keepers for the magnetic poles produced upon the pulleys. These magnetic circuits being exceedingly short and of remarkably low resistance, the attraction of the many keepers to the pulleys produces a great adhesion of the belt to the pulleys, thus permitting large powers to be transmitted through relatively small belts. Experience has shown that with a four inch pulley and a belt three inches wide, making contact only over one-half of the circumference, the belt will sustain a dead weight of two hundred pounds without the magnets reaching saturation. It will thus be seen that we have here, by a proper proportioning of the parts, a magneto-mechanical device capable of replacing the toothed wheels in nearly all cases of power transmission.

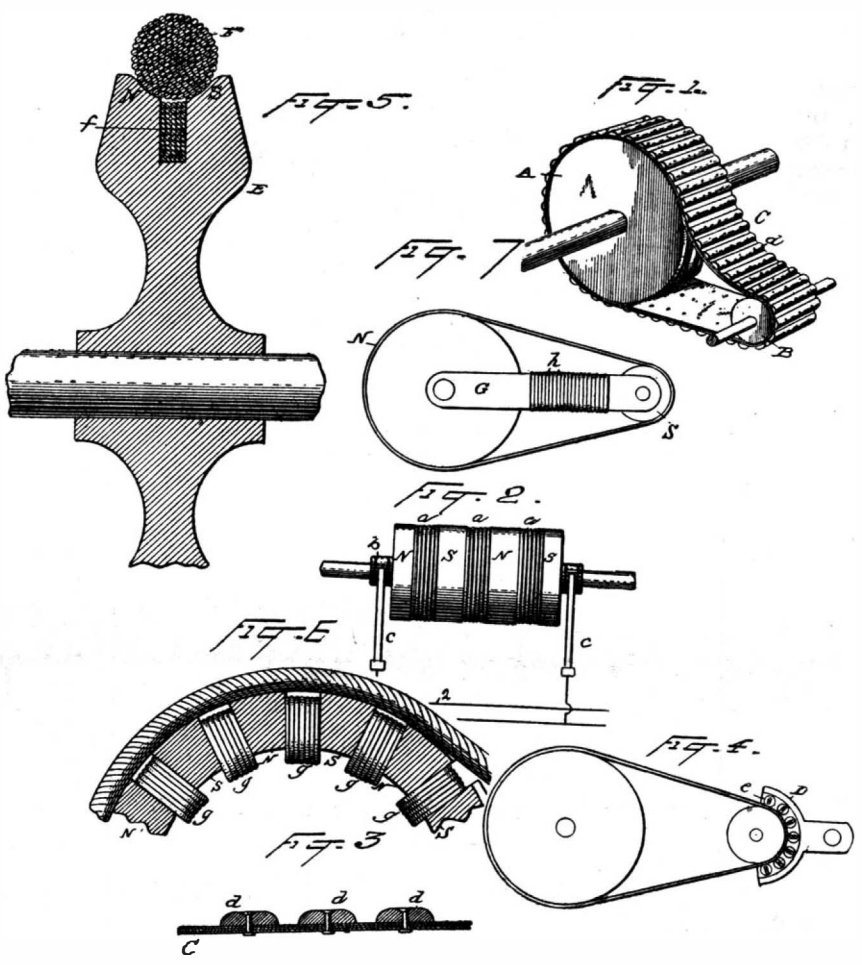
In Fig. 4 is illustrated a construction in which, instead of placing the bars, *d*, directly upon the belt, a frame, D, is placed on the contact side of one or of each pulley, and in this frame are mounted magnetic rollers, *e*, having slotted bearings so as to be capable of a limited movement toward the pulley. The belt passes under these rollers, and by the attraction of the rollers toward the pulley, the adhesion of the belt is increased.

In Fig. 5 the device is an iron wheel, E, provided with a grooved face in which runs a wire rope, F. The wheel is slotted circumferentially and provided with a magnetic winding, *f*, which strongly magnetizes the wheel, giving the opposite sides of its rim opposite polarities. The wire rope acts as an armature or keeper to the magnetic poles, forming a magnetic circuit of exceedingly low resistance and resulting in a powerful adhesion of the rope to the wheel.

Instead of winding the wheel, E, circumferentially, its rim may be provided with transverse grooves in which windings, *g*, will be placed, making the projecting surfaces of the wheels between these windings alternately of opposite polarity, as indicated in Fig. 6. The wire rope acts as an armature or keeper for all the magnets thus formed.

Instead of winding each wheel or pulley, in cases where the wheels or pulleys are sufficiently near to permit of the employment of the construction, the pulleys are connected by an iron frame, G, which is provided with the magnet winding, *h*, thus making one pulley of one polarity and the other of the other polarity, a magnetic belt, rope or chain being used to complete the magnetic circuit between the two pulleys or wheels. This construction does not produce as powerful magnets as in the constructions already described. It is simply given as an illustration of the fact that the invention is capable of being carried out in many forms of construction, and is not limited to the special constructions illustrated.

It is obvious that while a belt of magnetic material such as the laminated steel belt described is desirable, in order to secure the full advantages of the invention, yet the invention may be used to increase the adhesion of belts of non-magnetic material, such as leather, rubber cloth and the like. If the endless belt, C, of Fig. 1 were a leather or rubber cloth belt, it is evident that the magnetic bars, *d*, would increase the adhesion of the belt to the pulleys, while if the belt of Fig. 4 were of non-magnetic material, the magnetic rollers, *e*, would increase its adhesion.



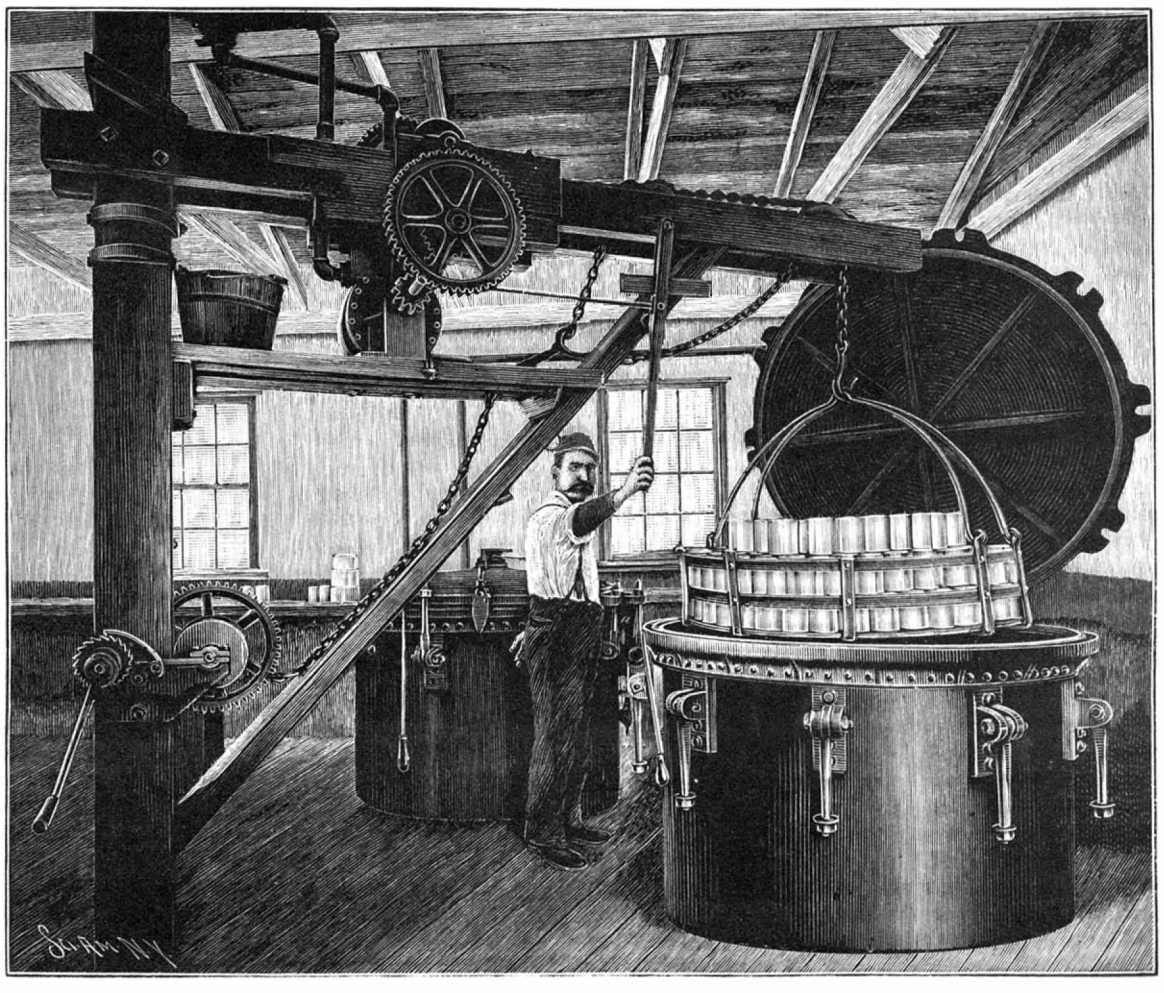
EDISON'S IMPROVEMENT IN THE TRANSMISSION OF POWER.

Electro-Mechanical Light.

An interesting illustration of the production of light by small mechanical effort is furnished by Mr. E. C. Rimington, in a description of a novel electroscope published in the *Electrician*. The writer refers to a paper entitled "Experiments in Electric and Magnetic Fields," read by himself in conjunction with Mr. Wythe Smith before the Physical Society last November, in which an experiment was given showing the illumination of an electrodeless vacuum tube rotated in a constant electric field between two charged plates. Mr. Rimington has since found that this experiment can be much more simply shown by bringing a rubbed ebonite or glass rod near to the rotating tube, when the set of double fan-shaped images of the tube will be developed nearly as brilliantly as when charged plates are employed. It is stated that an ebonite rod excited by being drawn once through a piece of dry flannel will produce one image when held at a distance of more than a foot from the tube, thus forming an exceedingly novel kind of electroscope. The tube is made of a straight portion 5 inches long of about the bore of a spirit thermometer, terminating in two bulbs. It is made T-shaped by the outlet, where it was connected with the air pump, and which serves as a means of attaching the tube to the motor that revolves it. "It is not, however, even necessary to employ a motor, as twiddling the tube between the finger and thumb by the T-piece when holding it near the excited rod enables the effect to be obtained." The illustration is an interesting one from the fact that the extra power, infinitesimally small, required to rotate the tube when in the electric field is "practically converted directly into light."

THE CANNED FOOD INDUSTRY.

At the oyster-canning establishments in Baltimore, where hundreds of tons of canned oysters are annually put up, the oysters are first canned and then partially cooked, whereby the air is expelled, the sealing of the cans is then effected, and the contents will then keep good for a long period. Our illustration shows the mode of cooking a large number of the oyster-filled cans. They are placed on the platform of a large swinging crane as shown, and then lowered into a great cooking boiler, the cover thereof is then closed and securely fastened by means of lugs as indicated in our engraving. Steam is then turned on, and when the mass of oysters is thoroughly heated through, the operation is finished. This general method of cooking is very expeditious and is followed in various other branches of the canned food industry.



THE CANNED FOOD INDUSTRY—THE COOKING BOILER.

ONE million three hundred and eighty-six thousand three hundred and thirty-two pounds is the estimated revenue of the French Ministry of Telegraphs for the present year, which is about £10,000 more than in the previous twelve months.

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THE COLUMBIAN EXPOSITION STEAMER CHRISTOPHER COLUMBUS.

The peculiar advantages of the McDougall whaleback attracted attention to it as a means of steamship travel from Chicago to Jackson Park during the World's Columbian Exposition, and the World's Fair Transportation Company of Chicago had built for this service the large steel passenger whaleback Christopher Columbus, which was constructed under the supervision of the inventor in the yards of the American Steel Barge Company. This is the first effort made to adapt the whaleback for passenger traffic, and the large size of the vessel makes the innovation in this field especially interesting. The Christopher Columbus was launched at West Superior, Wis., on December 3, in the sight of fifteen thousand people. This great vessel does not differ in any essential from the regulation whaleback. It is designed to carry five thousand passengers. The new vessel has seven turrets. These rise seven and a half feet above the deck, and are elliptical in form. They extend the full length of the vessel, and are occupied by the windlass, stairways to the saloon deck above and between decks below, air fans, stacks, ash hoists, engine room and machinery. The refreshment rooms are spacious and located amidships. Four gangways on either side are provided for entering and leaving the vessel.

The Christopher Columbus is 362 feet in length, has a beam of 42 feet and a depth of 24 feet. It has one screw, 14 feet in diameter, and a speed of 20 miles an hour is promised. Practically the entire deck supported by the turrets is devoted to the saloon proper. It is 225 feet long and 30 feet wide. The vessel has electrical equipment for lighting, and steam heating apparatus. A promenade deck, 4 feet wide, runs around the saloon, with more than 30 feet of space at the bow and stern. The promenade deck proper is above the saloon and is 257 feet long, with a skylight 15 by 138 feet in the center. An elaborate fountain in the center of the grand cabin will be one of the principal features of the boat. It is said that the run from the Lake Front at Chicago to the World's Fair grounds, a distance of seven miles, will be made in half an hour.

Magnetic Screens.

Mr. Smith, in *Nature*, describes a magnetic screen which he had constructed to protect delicate laboratory instruments from the magnetic action of a large dynamo which was within 60 feet of the test room. The three sides of the dynamo room nearest the laboratory were inclosed in a double brick wall, the space between the two walls being filled with scrap iron. The iron wall is about 8 inches thick. Delicate tests showed that this was an effective barrier to the magnetic influence.

Electricity at the Columbian Exposition.

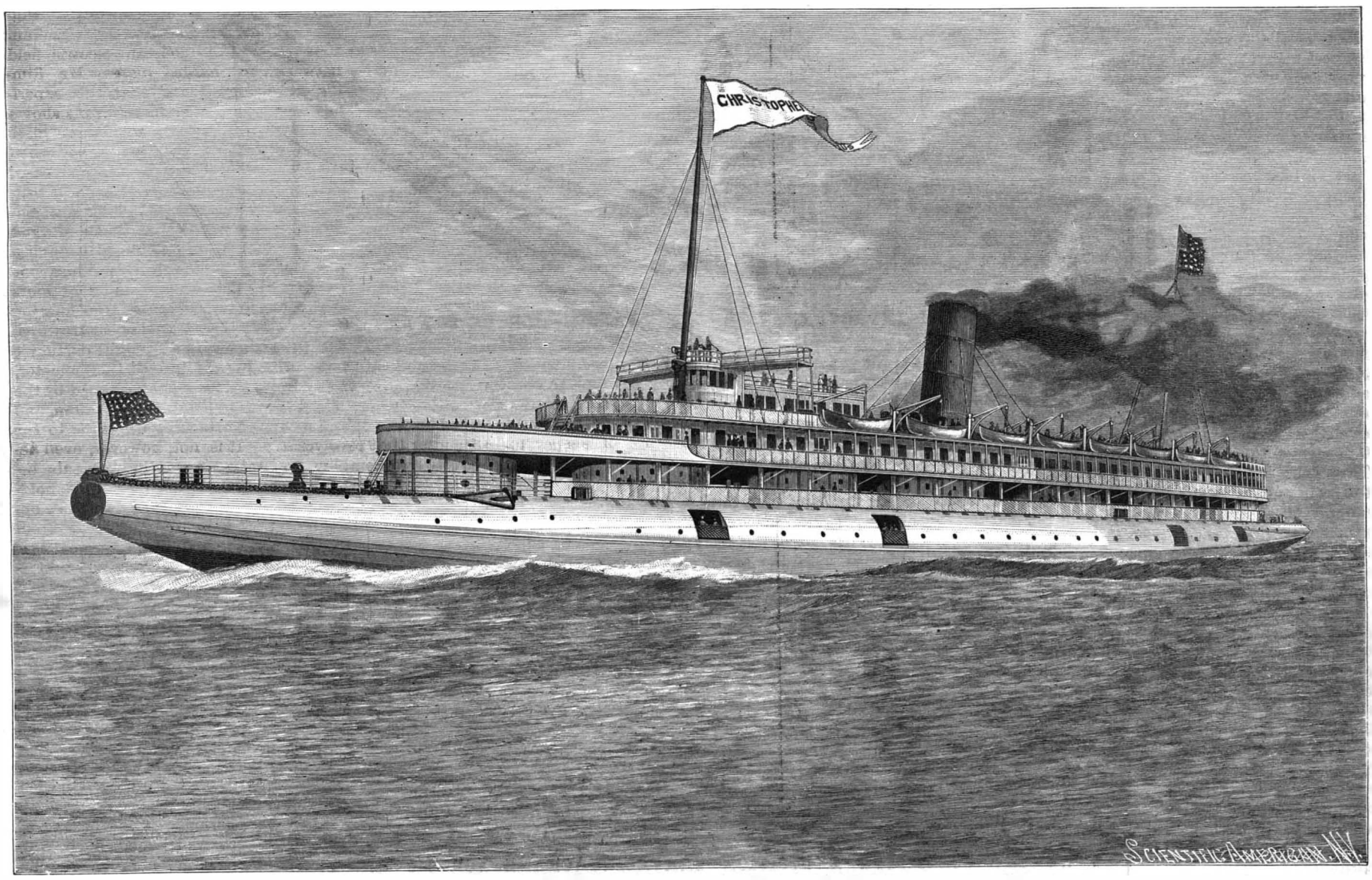
The latest developments in the practical uses of electricity are fully shown at the World's Columbian Exposition. There are no experiments or other demonstrations of the possibilities of this energy except what few are made by exhibitors. So far as the Exposition itself is concerned, the general scheme is to show as completely as possible the latest practices in the use of this energy, but not to enter the speculative field.

Electricity played an important part in the preliminary work of constructing the Exposition buildings and laying out the grounds. One of the very first buildings erected was a power plant, in which was installed considerable electrical apparatus. The grounds were lighted from this plant, and most of the lumber sawing was done by saw mills operated by electric motors. When a building was to be constructed, a portable sawing plant, of which an electric motor formed a part of the outfit, was placed in the most convenient position, connection made with the circuits which transmitted electricity throughout the grounds, and an abundance of power was at hand. In no instance up to date has electricity been used to such practical advantage in this country as was done in this work at the Exposition. Now that the Exposition is completed and in the hands of the public, it is interesting to note the marvelous extent of the practical uses of electricity.

Electric lighting in all its phases is very completely shown. The incandescent plant for lighting the Exposition has a maximum capacity of 180,000 sixteen-candle power lamps. This plant uses the alternating current system. Exhibitors in the Electricity building show all the advantages of the direct current system of incandescent lighting, and thus the capabilities of both systems are fully demonstrated. Besides this use of incandescent lamps, there is also shown a great variety of arc lamps designed for use on low-tension circuits. In the arc lighting plant most of the lamps are operated by the high-tension direct current, although there are a few alternating current arc lamps. Practically, every maker of arc lighting apparatus in the country is represented in this plant. French and German manufacturers also make an extensive and quite elaborate display of their lighting systems for ordinary lighting, and especially for special artistic effects, in which these nations have attained such perfection. The use of arc lamps of great power in the form of search lights is also fully shown, and they are used every evening that the Exposition grounds are open to the public, to heighten the illuminating effects.

Electric power, its transmission and utilization, are demonstrated on a far greater scale than has ever before been attempted. Five thousand or more horse power is transmitted electrically and used in various parts of the grounds. There is no very long distance transmission, however. Most of the electric energy generated for power purposes is the direct current, and it is used in the Palace of Mechanic Arts, the Electricity building, the Mining building, the Transportation building, the Agricultural building and the Manfactures and Liberal Arts building to a greater or less extent. Motors are operated for such service as running the traveling cranes, elevators, and for any purpose for which power is used, from a small fraction of horse power to units of 25 or 50 horse power. The most extensive use of electrical energy in one plant is in operating the Intramural Railway, which requires 5,000 or so horse power. In these various uses of electricity the adaptability of this energy for anything where power is needed, regardless of the size of the units, is fully shown. There is also an exhibit of the alternating current for power purposes. This is shown in the Electricity building by an exhibitor.

The storage of electric energy does not receive as much attention at the Exposition as its importance from an electrical standpoint deserves. This is because of the complicated condition of storage battery patents on account of legal complications and because of the fact that electrical storage has not yet proved a great success in this country in practical use. Nevertheless, there is one extensive demonstration of stored electricity in the electric launches which ply in the lagoon, canals and basin. There are fifty or more of these launches; all of them are operated by storage batteries. Exhibitors in the Electricity building also make quite an extensive show of the latest results that have been obtained in storing electric energy.



THE COLUMBIAN EXPOSITION STEAMER CHRISTOPHER COLUMBUS.

Stoppage of Chemical Action at Low Temperature.

From the results, recently published, of some investigations carried out by Pictet on the effect of low temperatures on chemical action, it would seem that there is a limiting temperature below which chemical affinity is not operative. Just as, at the other end of the scale, chemical compounds are broken up, their union being dissolved through the operation of dissociation, so, when the temperature falls below a certain point, substances which ordinarily evince a powerful affinity for each other become entirely inactive. From theoretical considerations, he had deduced the conclusion that chemical action should be impossible under these conditions, and his experiments show this to be the case. For example, slightly diluted sulphuric acid, solidifying at —56°, was intimately mixed at —125° with finely powdered caustic soda, and the mixture strongly compressed, but there was no sign of chemical action. On allowing the temperature to rise to —80°, action suddenly commenced, and became so violent that the containing vessel was broken. Similar results were obtained with sulphuric acid and potash. Concentrated am-

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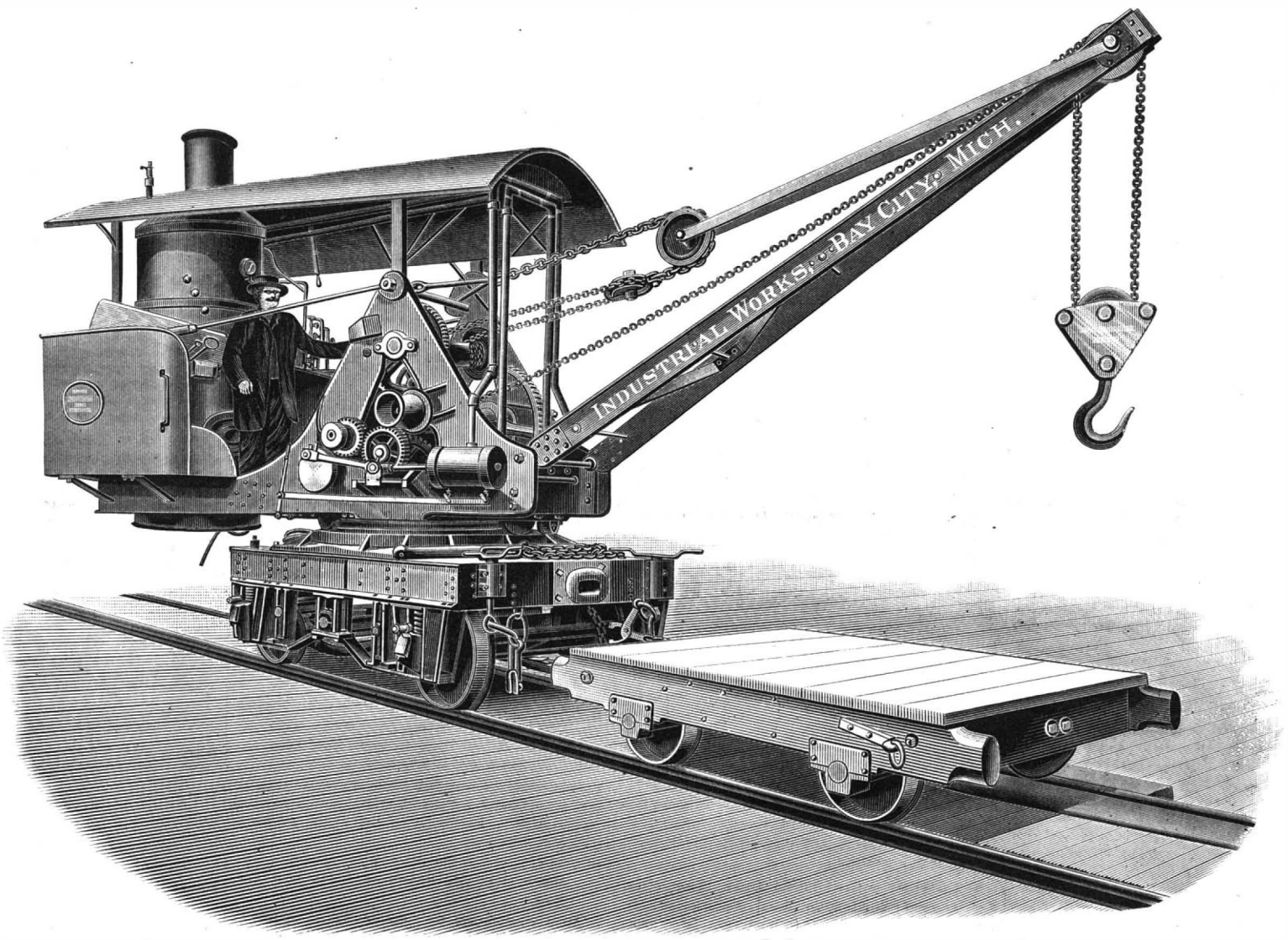
monia solution and sulphuric acid are without action on one another at —80°, but complete action suddenly sets in at from —60° to —65°. Common salt and sulphuric acid do not react at —50°, nor is there much action until the temperature reaches —25°. Moderately dilute sulphuric acid does not attack carbonates at —80°. Bubbles of gas begin to appear between —60° and —50°, but brisk effervescence does not set in until the temperature has reached —30° or upward. Similar results were obtained with nitric in place of sulphuric acid, but the temperature at which action commenced was rather lower in each case. Even the very sensitive vegetable colors are not affected at very low temperatures. Thus the litmus is not reddened by sulphuric or hydrochloric acid at —120°, and alcoholic potash does not give a coloration with phenolphthalein at —135°. From these and similar experiments, Pictet concludes that chemical reaction cannot occur between —125° and —150°.

AN EFFICIENT TRAVELING CRANE.

The work of installation of exhibits in the different buildings on the Fair grounds, during April and the early days of May, was greatly facilitated by the use of the very efficient and easily operated traveling crane shown in the illustration. Tracks were laid to every portion of the floor space of the various structures from all the railways, and it was a simple matter, with this machine, to transfer a heavy piece of machinery, a show case, or any bulky article, to the small platform car, and then employ the same power which had effected the lifting to draw the machine and car to the exact point where the exhibit was to be placed, and deposit it where required. The crane platform may be readily swung around and its arm conveniently adjusted to a greater or less angle, as desired, and the work of only one man is required for the operation of the machine.



THE WORLD'S COLUMBIAN EXHIBITION—TRAVELING CRANE FOR MOVING EXHIBITS.

Cardine—a New Heart Tonic.

Following the remarkable discovery of Brown-Sequard, of testicular elixirs and their sub-cutaneous injection for physical stimulation, comes Dr. William A. Hammond with a new preparation made from the hearts of animals, which he terms cardine. According to his accounts, as given in a recent paper in the New York *Medical Journal*, the new medicine is destined to play an important part in the treatment of all complaints pertaining to heart weakness and some other organs of the body. We make the following abstracts:

"Cardine, as used by me, is prepared as follows: One thousand grammes of the finely minced fresh heart of the ox, previously well washed in a saturated solution of boric acid, are submitted to the action of a menstruum consisting of twelve hundred grammes of glycerine, one thousand grammes of a saturated solution at 60° F. of boric acid, and eight hundred grammes of alcohol.

"The solution of cardine is a clear, transparent liquid, of a pale straw color, with the specific gravity of 1·070. Under the microscope, it exhibits no morphological constituents. It does not change, so far as I am aware, under any ordinary circumstances, and no bacteria possess sufficient vitality to exist in it.

"I have arranged the dose after many experiments upon healthy men and women of average size, and have accordingly fixed upon five minims as the proper dose of cardine after a maceration of from eight to ten months.

"The physiological effects of cardine, in their order of occurrence, as nearly as I can arrange them, are as follows:

"1. Within ten minutes the pulse becomes fuller, stronger, and sometimes more frequent. The sphygmograph shows this very clearly. The influence in increasing the force and frequency of the pulsations is remarkable, and it is still more remarkable that a tracing, taken eight hours subsequent to the injection, shows that the effect upon the heart was still present in a scarcely diminished degree.

"2. These tracings show what is also evident from a digital examination of the pulse—that the arterial tension is augmented.

"3. Increasing, as cardine does, the heart pressure, the effect upon the kidneys follows as a logical consequence. Many observations, made as far as possible under exactly similar conditions, establish the fact that the amount of urine daily excreted is increased by from ten to eighteen ounces.

"4. The number of red corpuscles in the blood is increased by the use of cardine.

"It is clearly a heart tonic of great power, a diuretic of notable value, and an agent capable of exercising a marked effect over the composition of the blood.

"In cases of cardiac weakness, from whatever cause it may arise, cardine is of inestimable value. It appears to me, from the few cases in which I have employed it in this connection, to be useful in fatty degeneration of the heart, improving the nutrition of the organ, not only by its action on the blood, to which I have made reference, but by its effects on the nervous organization of the cardiac tissue.

"But I have employed cardine more frequently in those cases of nervous prostration attended with anæmia and sometimes chlorosis. In such patients its action is so prompt and effectual as to excite surprise in all who have witnessed the change. In all these cases I have verified the great improvement in the appearance and apparent condition of the patients by the use of the hæmocytometer and hæmometer. In mild cases, a week or ten days' treatment has been sufficient, but never more than four or five weeks.

"As to the essential characteristics of cardine, while I am not able to give it a place in the nomenclature of organic chemistry, I am sure, from a consideration of the process by which it is obtained, that it is a substance derived from the heart. There is no escape from this conclusion. As to how it acts, I can at present only call attention to the theory that I proposed in my first paper on the subject, and that is briefly:

"That all the organs of the body possess the power, when in a state of health, of secreting from the blood the peculiar substance that they require for their nutrition, and that they take this substance and no other, never making a mistake in the matter. The brain separates brain substance; the heart, heart substance, and so on. If through disease or from derangement of function they lose this power, or if the peculiar pabulum they require be not in the blood in sufficient quantity, their functions cease to be normal. General debility, producing a diminution of nerve force, may cause the loss of this power, or it may result from local disturbance either of structure or function or some profound shock to the organism may so interfere with hæmatosis that the blood no longer contains the material which the organ needs. In either case, if we supply to the blood the peculiar principle which a diseased or disordered organ requires, we do that which nature, unassisted, cannot or does not do.

"Cardine, therefore, if this theory of its action be correct, nourishes the heart. It is the substance which an ill-conditioned heart must have for its well being. It is already in a fit form for assimilation, and it acts with a promptitude, a certainty, and a degree of permanence of which no other heart tonic within my knowledge is capable.

"It follows, also, that in all weak conditions of the system, and especially in those in which the blood is below the normal standard, cardine must prove to be of inestimable value. And in other and more serious affections, such as those in which depurative organs of the body, especially the kidneys, fall below the healthy standard of functionation, cardine, increasing as it does the heart pressure, may augment the bodily comfort and materially prolong life.

"Cardine is not an annihilator of the influence of old age, but my experience convinces me that it lessens the effects of this factor of deterioration so far, at least, as the heart is concerned. This organ, as is well known, is one of the first to fail in physiological power, and this is shown not only by the examination of the pulse and of the heart itself, but by the accumulation of fluid, especially in the lower extremities, owing to a diminution of the heart pressure. Cardine, taken in conjunction with cerebrine, assuredly counteracts this influence, for, owing to the increase of the cardiac pressure, the passive anasarcous condition disappears, and the other indications of heart weakness are either greatly mitigated or altogether abolished."

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RECENTLY PATENTED INVENTIONS.

Engineering.

TO REDUCE AND SMELT SULPHIDE ORES.—Augustus L. Engelbach and Sidney E. Bretherton, Leadville, Col. A specially designed furnace is provided by these inventors for carrying out a method of reducing and smelting by which air is forced through a series of retorts heated by the matte and slag discharged from the blast furnace, and hydrocarbon gas injected into the heated air to produce an oxidizing flame which is forced into the blast furnace to reduce the ore. A channel in the wall of the crucible of the blast furnace is connected by tuyeres with the interior of the furnace, and connected with the channel is a combustion chamber connected with an oven containing retorts, the oven heating the air passing through the retorts, while through a nozzle extending into the combustion chamber passes a mixture of steam and oil.

Railway Appliances.

CAR COUPLING.—Valentine Erbach, Scranton, Pa. According to this invention a flat gravity coupling pin having a transverse concavity in its lower end is combined with a gravity locking and tripping dog in the drawhead, the dog being adapted to be acted upon by an entering link, and having a bearing surface to receive the lower end of the pin. The pin is held in elevated position to admit a link, the entry of which operates to trip the pin and cause it to be guided downward in the link. The pin may also be brought into such engagement with a link as to give the latter an upwardly inclined position, and thus hold it until readjustment or until a coupling has been effected.

CAR BRAKE.—Thaddeus J. Barrow, Duluth, Minn. This is a brake especially designed for use on street railway cars, occupying but little space beneath the car, and having a series of independent shoes. It comprises three-armed levers pivoted on opposite sides of the car truck, brake shoes pivotally connected with opposite arms of the levers, and operating levers connected with one arm of the three-armed levers. The shoes are operated independently, and if one or more of them should break, the others would do the work, while the lever mechanism allows the shoes to be set with great rigidity upon the wheels.

ELEVATED RAILWAY BRAKE.—John N. Valley, Jersey City, N. J. This is a brake for use on a railway in which the cars are suspended from an overhead track or stringer, and the invention consists of a mechanism in the form of a clamp, formed by the brake jaws or shoes, to clamp the rail or stringer. The brake is easily applied or released by an operating lever within the car.

Electrical.

ELECTRIC PROGRAM CLOCK.—Henry C. Hain, Booneville, Mo. This invention provides a clock attachment for giving calls at different times in the day and different days in the week, as a reminder of engagements, etc. An auxiliary dial has a series of openings and equidistant electrical contacts in a circle on the inside of the dial, there being also a contact arm adapted to inclose an electric circuit, mechanism between the clock and arm, and removable pins to be inserted in the openings in the dial.

ELECTRIC RAILWAY TROLLEY.—Wesley W. Pritchett, Ogden, Utah Ter. This invention provides a simple and cheap trolley mechanism to be carried on the top of a car, designed to hold the trolley wheels always in contact with the wire, and to guide the wheels to the wire when the trolley is to be applied. A shifting weight holds the trolley wheel in contact with the line wire, means being provided for shifting the weight and trolleys when the car is to be reversed or switched, which may be quickly done from the platform in such a way that the lights on the car will be but momentarily put out.

Mechanical.

ANTI-FRICTION BEARING.—Charles W. Wynn, Asheville, N. C. This bearing may be used on a revolving as well as on a fixed axle, and consists of a number of cages each containing longitudinally arranged rollers, and provided at their meeting ends with interlocking projections, whereby the rollers of each cage will be in line between those of the next cage, the rollers bearing evenly within a cylindrical bore. By the cages revolving on the spindle and distributing the wear, it is designed to avoid the wearing of the spindle flat on one side.

LUBRICATOR.—Benjamin F. Howard, Sheep Ranch, Cal. This is a device more especially designed for use on engine cylinders to automatically and positively feed the proper amount of lubricant into the cylinder. It has a large oil reservoir into which passes a limited amount of condensation water, and a sight feed tube so arranged that the oil bubble passing through the tube can be seen and the amount closely regulated, being also indicated by a pointer on a graduated dial.

WRENCH AND CUTTER.—Theodore Fletcher, Macdona, Texas. This is a strong, simple, and inexpensive tool, adapted for use for ordinary purposes as a wrench, to turn a nut, or as a pipe wrench, the clamp or pressure being applied in both cases with a power proportioned to the strength of the pull, while it may also be used as a powerful pipe cutter. Its construction also allows it to be used very rapidly, somewhat as a ratchet wrench.

Miscellaneous.

REFRIGERATOR.—George A. Bowen, Fond du Lac, Wis. The box or casing of this device consists of two hinged sections, the lower one forming a provision chamber, supporting in its upper portion an open-top ice receiver, while the hinged upper section has an opening in its top closed by a cover, and registering with the open end of the ice receiver. The construction insures the keeping of the interior of the refrigerator at a uniform temperature, and permits of conveniently removing the several parts for thoroughly cleaning the interior.

TEACHING BOTANY.—William H. Gibson, Washington, Conn. A mechanical educational appliance, for use by lecturers and in schools, colleges, etc., is provided by this invention, to facilitate explanations of the construction of plants and the means employed for fertilization or fecundation, and cross fertilization and dissemination or dispersion of seed and fruit. The invention consists principally of a mechanical plant and means for actuating the floral parts and the seed receptacle and seed, different mechanisms being necessary for the demonstrations called for of different plants, and these mechanisms being provided for the different typical plants chosen by the illustrator.

LOCK BRAKE.—Volney W. Mason, Providence, R. I. This is a brake for hoisting machines, with which any required amount of pressure may be applied to the wheel, which may be securely locked so that it will not turn under any load the machine is likely to carry. The brake lever, attached to the brake, is moved and locked by an adjustable toggle joint, an operating cord and counterweight being arranged in convenient position to facilitate applying and releasing the brake.

PAINT FILLING COMPOSITION.—Richard J. Parke and Isaac Goodman, New York City. These inventors provide a composition consisting of cotton, wool, or silk flock, and pulverized stone, with varnish, japan, and oil, to be applied to wood preparatory to varnishing, the coating being susceptible of polishing and smoothing with pumice stone or other material, after which varnish may be applied in the usual manner, the paint or varnish then not penetrating into the wood.

WATER GATE.—Christopher H. Watson, Riverside, Cal. This invention provides a gate of simple and durable construction, easily opened and closed, and designed to prevent all leakage by firmly seating and locking the gate over the opening. A gasket of rubber or similar material is held on the inner face of the gate proper, the gate being mounted to slide, and being carried by a stem which may be turned, the gasket not being injured while the gate is partly or wholly open, and being used only when the gate is entirely closed. The gate, when pulled up, can be locked in any desired position by turning its stem.

TOBACCO AND CIGAR BOX.—Theodore V. Smith, New York City. The storing and preserving of cigars and tobacco, to keep them in good condition, is the object of this invention, the box having a lining of water and moisture proof material, and being designed to receive absorbent pads for keeping the cigars and tobacco at a certain degree of moisture. The construction is durable and inexpensive, and all the parts can be readily removed to clean when needed.

CANVAS COT.—Camille Poirier, Duluth, Minn. This cot is more especially adapted for use in steel prison cells, the body of the cot being so connected with the hanging devices that the latter may be readily removed from the canvas, and all may be easily and thoroughly cleaned. The construction of the cot and hangers is such that nothing pertaining to them can be used by a prisoner as a weapon.

TAILOR'S INSEAM GAUGE.—Harry M. Cloud, Cincinnati, Ohio. This is a device for taking the inseam length, from the crotch to the feet, in measuring for trousers. It is a form of measure in which a standard, supported on a suitable base, is provided with a sliding and vertically adjustable section marked with graduations, and having a horizontal arm to be lifted between the legs as far as the crotch. It is designed that by this means the work may be more accurately and conveniently done, while a man may therewith correctly take his own measure.

GAS BURNER.—Daniel Daly, Maysville, Ky. According to this invention two approximately parallel tubes or sections have in their adjacent faces opposite slots, so that the gas issuing therefrom will come together and merge in a single flame. The commotion and suction produced by the currents of gas coming together are designed to serve to mix air with the gas to produce a hot, heating flame, the amount of air drawn in being varied by varying the distance between the tubes and changing the angle at which the gas flames impinge on each other.

MATCH BOX.—Edward J. Hill, London, England. This box, which is also adapted to hold cigarettes, cigars, lozenges, and other small articles, is preferably made of a single sheet of stamped or cut sheet metal, foldable in such a manner as to form a complete self-closing spring box. It has a movable part forming a container and a discharge orifice with which the movable part does not normally communicate, but with which, by reason of the spring action, it may be made to communicate for the discharge of the articles one at a time.

Designs.

TEA POT.—Charles Osborne, New York City. The leading features of this design are the heavy leaf-like borders of the upper and lower portions of the pot, the ornamentation at the base of the spout and at the points where the handle connects with the pot, and its faceted sides.

POCKET BOOK CASE, OR WALLET.—Charles Scheuer, New York City. The article made after this design is intended to present the appearance of a letter, one side showing the lines of joining of the tabs and the other showing simulations of a canceled stamp, postmark, and address.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

ART OUT OF DOORS; OR, HINTS ON GOOD TASTE IN GARDENING. By Mrs. Schuyler Van Rensselaer. New York: Charles Scribner's Sons. Pp. 398.

This is an exquisitely beautiful book typographically. It is not a practical treatise on gardening, but a series of essays on different kinds of gardening and other means of beautifying grounds, pleading for the more general recognition of this class of work as one of the high arts. It seeks to impress upon the reader the importance of "aim and method" in the art of gardening, now "practiced much more often than any other in ignorant, impulsive ways, by people who never stop to think that it is an art at all." The impressions gained by extensive observation are here noted with a refined taste and with an orderly arrangement of widely different branches of the subject which make the book excedingly attractive.

THE STATISTICIAN AND ECONOMIST—1893, 1894. San Francisco: L. P. McCarty. Pp. 672. Price, cloth, $4.

This is the seventeenth issue of a volume which has been successively enlarged year by year, and which gives a great deal of very many kinds of curious and useful information. Its topics include population, election returns, important laws, historical data, trade statistics, geographical information, useful facts in mechanics and engineering and numerous other subjects. A full index facilitates reference to the contents.

OUT DOORS is the title of a neat little paper-covered book, sent by mail for ten cents, and published by the Pope Manufacturing Company, of Boston. Lawn tennis, yachting, foot ball, base ball, horsemanship, rowing, canoeing, and cycling, are each treated in a most interesting manner, by a writer of reputation. The primary object of the book is to give added interest to all kinds of outdoor exercise, thereby naturally drawing more attention to bicycling, and for this reason the book is issued. The book is calculated to effectively preach the gospel of outdoors—fresh air.

Received.

CONFLICT OF THE NINETEENTH CENTURY: THE BIBLE AND FREE THOUGHT. By Rev. Thomas Mitchell. New York: The Universal Book Company.

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SCIENTIFIC AMERICAN BUILDING EDITION.

MAY, 1893.—(No. 91.)

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2. Plate in colors showing a handsome residence at Rutherford, N. J. Two perspective views and floor plans. Mr. F. W. Beal, architect, New York. An attractive design.
3. A handsome dwelling at Plainfield, N. J. Perspective views and floor plans. A model design. Messrs. Hartwell & Richardson, architects, Boston, Mass.
4. A dwelling at Utica, N. Y., erected at a cost of $4,700 complete. Floor plans, perspective view, etc. Mr. W. H. Symonds, architect, New York. An Old Colonial style of architecture.
5. Engravings and floor plan of the Fairfield Congregational Church at Fairfield, Conn., erected at a cost of $52,000. Messrs. J. C. Cady & Co., architects, New York City.
6. A stable erected at Plainfield, N. J. A model design. Messrs. Hartwell & Richardson, architects, Boston, Mass.
7. An excellent design for a modern stable at Bridgeport, Conn. Messrs. Longstaff & Hurd, architects, Bridgeport, Conn.
8. A residence at Belle Haven, Conn. A very picturesque design, perspective elevation and floor plans. Cost $6,000 complete. Mr. Frank W. Beal, architect, New York City.
9. View of a tasteful shop for a builder erected at Neuilly, Paris.
10. The Fifth Avenue Theater, New York.—View of the Worthington steam fire engine pump.—View of the Hygienic Cement and Asphalt Company's watertight scene pit. View of the Edison Electric Illuminating Company's switchboard, with particulars of construction, etc.
11. Miscellaneous contents: A Pacific coast bathing establishment.—An improved spring hinge, illustrated.—The Lewis open fire base burner, illustrated.—The J. A. Fay and Egan Co.—The H. W. Johns paints, etc.—An adjustable sash holder, illustrated.—A labor saving screw driver, illustrated.—A self-feed rip saw, illustrated.—Shipping a factory across the Atlantic.—Architectural wood turning.—Tunneling the Simplon.—New resawing band saw machine, illustrated.—The Wheeler wood filler.—An improved hip shingle, illustrated.

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(4982) J. E. D. asks how a well that has not been used for some time can be cleaned, and if the water can be made drinkable without drawing it all off. A. It is not safe to use the water of a well that has not been recently used until a thorough examination has been made as to the possibility of its containing dead animals. If you are assured of this by examination, or by the smell of the water as drawn and by heating, then a thorough pumping will remove so much of the water that the fresh incoming water will make the well safe for household use for washing and finally for cooking; but we do not recommend it for drinking for some time after it has been in use for other purposes.

(4983) J. G. H. asks: Is a cantilever bridge a truss bridge? How long a span has ever been built constructed on similar plan to one on front page of recent number of SCIENTIFIC AMERICAN? A. A cantilever bridge is a truss bridge of a particular type or construction of truss. The Forth Bridge in Scotland has the longest cantilever spans yet made. In this bridge there are two spans of 1,710 feet each. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 478, for illustrated details and description.

(4984) J. G. R. says: Can you give me any points on tempering springs made of cast steel wire, No. 8 gauge, about 6 inches long? A. For tempering steel springs as described, heat the springs in a fire that is only moderately hot and large enough to heat the whole spring evenly. A muffle is preferred where many are to be done. When the springs are at a cherry red heat, they are to be plunged endwise into an oil bath (lard oil); then heated with the oil on them in the muffle or a slow fire until the oil takes fire; then plunge them into the oil bath. A plain, straight spring is very easy to

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manage. Coiled springs of a helix or volute form are more difficult to temper, and require much care in heating evenly. In establishments where quantities are required, special ovens are built for heating and drawing the temper. Red hot lead in a crucible is also much used for heating evenly.

(4985) E. P. M. writes again: Thank you very much for the answer to my question, No. 4742, E. P. W., in the SCIENTIFIC AMERICAN of March 18. You say it would take 16 horse power to maintain the 1,000 pounds pressure with a ½ inch discharge. Now would you be kind enough to tell me how you worked the example, and give me the exact diameter and stroke of both the steam cylinder and of the water plunger, and how many strokes per minute it would require to maintain the above pressure with the ½ inch discharge? Also, what boiler pressure of steam and how much water it would discharge per minute? A. The theoretical velocity of water from a nozzle is equal to the square root of the height in feet due to the pressure multiplied by square root of twice gravity ($\sqrt{2g.h.}$) = feet per second. Then 1,000 pounds × 2·3 = 2,300 feet as the head due to 1,000 pounds pressure. The square root of twice gravity (64·33) = 8·02, and the square root of 2,300 = 47·95. Then 47·95 × 8·02 = 383·55 feet per second, or 23,013 feet per minute. The friction of a nozzle may reduce this to 20,000 feet per minute. The area of a ½ inch hole is 0·1963 of a square inch. Then 0·1963 × 20,000 feet × 12 inches = 47,112 cubic inches of water delivered per minute. If a pump makes 100 strokes or 50 revolutions per minute, then $\frac{47,112}{100}$ = 471+ cubic inches as the capacity of the water cylinder. Assuming 10 inches for the length of the stroke, then $\frac{471}{10}$ = 47+ square inches as the area of the piston. Adding a small percentage for leakage, an 8 inch piston will be the proper size. The area of the 8 inch piston = 50+ square inches and the pressure 1,000 pounds, the total pressure will be 50,000 pounds. If you intend to carry 100 pounds steam pressure, then $\frac{50,000}{100}$ = 500 square inches as the area of the steam piston. To this you should add 25 per cent for pump friction, or a piston area of 625 square inches, which is equal to 28¾ inches as the diameter of the steam piston. Then for the horse power, 625 square inches × 100 pounds × 83·3 feet piston travel = $\frac{5,206,250}{33,000}$ = 157·6 horse power. A decimal error made us say 16 instead of 160 horse power in former answer.

(4986) W. E. C. says: 1. In the use of a steam boiler for furnishing steam for a 100 horse power engine, dry kiln, and heating buildings, to maintain a pressure of 80 pounds during the day and 30 pounds during the night, which will be the safest, best, and most economical way of feeding the boiler with water from a well 12 feet deep? A. The proper way to feed your boiler from a well is through a steam pump with pistons proportionate for the work. You cannot trust the boiler to the tender mercies of the pump acting automatically. Nothing but the care of the engineer will do for steaming at night, even under low steam. The water gauge should be connected direct to the boiler, and not through the feed pipe. 2. Will a water column on a steam boiler show correctly the amount of water in the boiler if I connect it with the water with 1¼ inch pipe and with the steam with 2 inch pipe? A. One inch pipe is large enough for water gauge connections, unless the water is hard, when 1¼ inch for both connections is preferred. It will not show water height correctly when connected with feed or blow-off pipe.

(4987) D. S. W. writes: 1. I want to make a small storage battery. Will you kindly give me a "point" or two? How shall I prepare the red lead and litharge? A. Mix the red lead and litharge with dilute sulphuric acid; acid 1 part, water 9 parts. 2. How much of the surface of the plates should be covered with same? A. As much of the plate as is exposed to the electrolyte. 3. What proportions of c. p. sulphuric acid and water for the fluid? A. Acid 1 part, water 11 parts. 4. I intend using lead plates, 5 × 6 × ¼, four plates to each cell, and I want to make four cells. What E. M. F. should I get from it? A. Two volts per cell.

(4988) W. Y. asks: Do you know of a good cement for bedding brass inlaying in wood? I find that ordinary glue does not hold it well when the furniture is subjected to hot air furnace heat, whereas some very old furniture that I have with brass inlaying in it appears to stand perfectly well. A. For metal inlaying the toughest glue, which may be known by bending in the hands, should be used. Make the glue in the ordinary way, and to each pint add a half ounce of glycerine and a half ounce of fine whiting or pulverized chalk. Thoroughly incorporate and use hot and rather stiff. The metal should also be treated by dipping in weak nitric acid for a half minute, rinsing, and drying. This will give it a suitable roughness for holding the glue.

(4989) E. L. K. asks: Will you please give me your judgment in the matter as to whether you consider open hearth bar steel to be superior in quality, toughness, and uuiformity over that of Bessemer steel, and whether you would consider a tool made from open hearth steel as giving better and more satisfaction than that of one made from Bessemer? A. The open hearth steel is becoming a favorite where extreme toughness is required, as for boilers and structural work subject to great stress. The actual difference is not great, and it is only in the extreme tests of doubling a plate two ways and hammering flat without a flaw that open hearth takes the lead. Neither steel is used for cutting tools.

(4990) A. B. M. writes: I have a new electro-magnet for striking a bell and it does not demagnetize quick enough. Please inform me what iron should be used, what treatment it should have, if any, if it should be devoid of carbon, or what its constituents should be. A. The cores of electro-magnets should be made of the finest and softest wrought iron. Possibly you may be able to correct your magnet by thoroughly annealing the cores; this you can do by heating them red hot and placing them in ashes or powdered lime to cool. The armature should not be allowed to touch the magnet core; if it does, it will stick. You can prevent this by limiting the movement of the armature, by inserting a short copper pin in the end of the core, or by pasting a piece of paper to the face of the armature.

(4991) L. E. K. asks: 1. What is the resistance of a 16 C. P. 50 volt lamp in ohms? A. About 50 ohms. 2. What should be the thickness of mica between commutator segments in 8 light dynamo? A. One thirty-second of an inch. 3. How to remedy heating of field magnets. A. If it is a shunt machine, increase the resistance of the field magnet and add outside resistance. 4. Will it injure storage battery to take elements out of acid and dry and lay away for future use after it has been used a short time? A. No.

(4992) W. K. writes: I have made an induction coil, something in the style of the one described in Hopkins' "Experimental Science." Core 12 inches, consisting of 500 No. 20 soft iron wires. Primary of two layers No. 16 (B. and S. gauge) double cotton-covered copper wire. Secondary consists of 3 inches silk-covered copper wire, No. 36 (B. and S. gauge), closely wound and very carefully insulated throughout with paraffine and paraffine paper. Sections separated by about 1 inch solid paraffine, with 6 cells Fuller battery. It gives 3 inch to 3½ inch sparks. Since making this coil I have noticed that in nearly all the descriptions of coils that I have seen, heavier wire for the primary is advised. Is No. 16 (Am. gauge) sufficiently heavy to carry the current of above battery? A. Yes. Would I be likely to get a much stronger spark if I should wind on say 2 inches more of No. 36 on secondary? As there is plenty of space for it on the bobbin, I would put it on, if it would increase the spark materially. A. Your coil yields remarkably good results. We would not advise making any change in its construction.

(4993) G. E. F. writes: In reply to H. D. (4873), I have had occasion to replace broken teeth in small cast iron gears, and find the most effective way to be by drilling holes and tapping them for a screw thread, then screwing in strong iron bolts till the thread binds sufficiently to hold the tooth, and then cutting off and shaping with the file. If the tooth must be of perfect form, shape one out and fasten it by a sufficient number of set screws, with countersunk head, the square part of screw being cut off after fastening.

(4994) J. H. asks the manner by which nail hammers are tempered in large hammer factories. Also, is the grinding and polishing done on wheels or belts, or both? Is there an automatic machine for grinding hammers? If you could not inform me on this, kindly refer me to parties that could. A. Hammers in quantities are heated in large slow-burning fires or muffle ovens, and dipped in water either singly or in nests, strung on rods through the eyes. The grinding is done on large grindstones as to the plane parts, and angles and corners are ground on emery wheels. The finish is made on fine emery wheels and polishing belts of leather. Do not know of automatic machinery for hammer grinding. Possibly some of our readers may know of such.

(4995) W. T. asks: Can a clear-cut casting of Babbitt metal be made in a sand mould, and, if so, how can the casting be cleaned without marring or injuring the design? Can a clear-cut casting of medal or coin bronze be made in a sand mould, and, if so, how can it be cleaned without marring or injuring the design? Can such bronze be melted in a forge, and does it melt as easily as iron? A. Clean-cut or smooth castings cannot be made in sand. Babbitt and type metal can be cast in metal moulds clean and bright. Medal bronze of copper and tin alloy can be melted in a forge fire in a black lead or Hessian crucible to the extent of two or three pounds very easily, by banking the fire by placing bricks around it. It melts much easier than iron. By using fine moulding sand, such as used by brass founders, a fair casting may be made in moulds of medallion work that can be finished with but little work.

(4996) A Printer asks: Will you kindly tell how engraving and plate printing is done? I refer to that which is seen on statements and calling cards. A. Plates for plate printing are cut by means of gravers. The ink, which is very thick, is rubbed into the grooves or lines made by the graver. Any surplus ink that remains on the plate is removed by a cloth. The printing is effected in a roller press by pressing the paper into the inked lines.

(4997) S. B. asks: Will you please tell me how they make calcium lights burn that they use in the theater, and how much they cost? A. A calcium lamp costs about ten dollars. The light is produced by directing a jet of hydrogen or of coal gas and a jet of oxygen gas against a stick of lime. The lime is thus heated very hot and becomes luminous.

(4998) F. S. K. writes: 1. I should like to ask whether there will be an archeological exhibit at Chicago, especially of Grecian, Roman, and Babylonian carving. A. We have not yet received the lists of the Columbian exhibit. 2. How much is the pressure caused by water freezing? A. Water exerts an immense force by freezing when confined in an unyielding vessel, probably many thousand pounds per square inch. It has burst bombshells when plugged full of water. 3. Would a greater quantity of water cause greater pressure? A. The pressure per square inch would be increased with the increase in volume in an unyielding vessel. 4. How could I make a simple instrument for measuring the humidity of the atmosphere? A. The simplest hygrometer is a strip of strong paper, ½ inch wide, fastened at the top of a plastered wall or on a strip of wood, with a small weight hung at the bottom to keep the paper straight. It will expand and contract with the changes in the atmospheric moisture. A piece of catgut, a few inches long, hung with a weight to keep it straight, and a pointer attached, has a large range of motion, due to change of moisture in the air.

(4999) G. C. asks: Are lightning rods of any use in protecting a building during an electrical storm? If so, how many are needed on a building 36 by 72; 30 feet high? How are they to be put on? Are they manufactured or for sale in any of our Western cities, and if so, by whom? A. Lightning rods are of use. It requires a rod to every 225 square feet, or to every area 15 feet square. They may be nailed directly to the building if the rods are made of strips of copper. The points should be about 5 or 6 feet above the roof. We presume almost any dealer in electrical supplies in your State could furnish you with lightning rods. We advise you, however, to have your lightning rods put up by some one who understands the business. The rod is of no value unless it has a good ground connection.

(5000) P. C. W., H. N. G. and others ask how to make cheap filters. A. We give two forms of inexpensive filters, both taken from our new Cyclopedia of Receipts, Notes and Queries. To make a filter with a wine barrel, procure a piece of fine brass wire cloth of a size sufficient to make a partition across the barrel. Support this wire cloth with a coarser wire cloth under it and also a light frame of oak, to keep the wire cloth from sagging. Fill in upon the wire cloth about three inches in depth of clear sharp sand, then two inches of charcoal broken finely, but no dust. Then on the charcoal four inches of clear, sharp sand. Fill up the barrel with water and draw from the bottom.

Another form of filter using stone pots is given below; of course two barrels may be substituted for the stone pots if desired. Use two stone pots or jars, as shown in the accompanying engraving, the bottom one being a water jar with side hole, if it can be procured, otherwise, if no faucet can be used, the top jar can be removed to enable the water to be dipped out. The top jar must have a hole drilled or broken in the bottom, and a small flower pot saucer inverted over the hole. Then fill in a layer of sharp clean sand, rather coarse, a layer of finer sand, a layer of pulverized charcoal, with dust blown out, then a layer of sand, the whole occupying one-third of the jar.

(5001) W. F. C. asks: What is the expansion of railroad bar iron per foot for each degree Fahrenheit? I mean when exposed to the heat of heat the sun. A. The expansion of ordinary bar iron between the temperatures of 32° and 572° is 0·0000826 of an inch per foot for each degree of heat Fahrenheit. The greatest range of temperature in rails through the year in your climate is about 90°, amounting to a change in length for 100 feet of 0·7434 of an inch, or nearly 7½ inches to a thousand feet. The extreme difference for a 30 foot rail is 0·223 of an inch. Rails laid at mean temperature of 60° require 0·148 of an inch space for 30 foot rails. In ordinary practice a ⅛ inch gauge is used in summer.

(5002) F. P.—The following preparation is used to render starched goods pliable: Take of white wax 1 ounce, spermaceti 2 ounces, melt them together with a gentle heat. When you have prepared a sufficient amount of starch, in the usual way, for a dozen pieces, put into it a piece of the polish about the size of a large pea, using more or less according to large or small washings. Or thick gum solution (made by pouring boiling water upon gum arabic) may be used. One tablespoonful to a pint of starch gives clothes a beautiful gloss. Leclanche battery prism is composed of 40 parts granulated manganese dioxide, 52 parts granulated carbon, 5 parts gum shellac, 3 parts potassium bisulphate. Mix, heat to 212° Fah., and compress in moulds under a pressure of two tons, or press with moderate pressure in the porous cells.

(5003) P. J. L. says: I would like to know if there is any way of killing the odor of kerosene. That is to add something to it so that there will be no smell of the oil or what is added. Also how to make camphor oil cheaply. A. The odor of kerosene may be modified, if not entirely destroyed, by using the following following formula: Mix chloride of lime with petroleum in the proportion of three ounces for each gallon of the liquid to be purified. It is then introduced into a cask. Some muriatic acid is added and the mixture is well agitated, so as to bring the whole of the liquid into intimate contact with the chlorine gas. Finally the petroleum is passed into another vessel containing slaked lime, which absorbs the free chlorine and leaves the oil sufficiently deodorized and purified. Camphor oil is made by allowing the crude camphor to remain packed loosely over a wire grating, so that the oil may drain out. This method, which is crude and wasteful, is gradually giving place to hydraulic pressure.

(5004) C. W. H. asks: In what country was tempered copper found? What century was it supposed to have been done? Is it a fact that we have no tools now that will make an impression on said copper? Where can I get a history on such a subject? A. The so-called tempered copper tools are supposed to be of Egyptian or Hindoo origin, and were an alloy of copper and tin. Supposed to have been of the bronze age, one to two thousand years before the Christian era. The same kind of tools can be made now; they are inferior to steel, which will cut the copper. There is no special history. They are only alluded to in works on ancient Egypt.

(5005) H. E. N. asks: Will you please give me a receipt for a mucilage for mounting plants in a herbarium? Was there ever a book published giving the flora of Nebraska? If so, give name of publishers and price. A. Glycerine, 4½ parts; soft soap, 4½ parts; dissolve 1½ parts salicylic acid in 30 parts alcohol. Shake thoroughly, and add to a mucilage made of 139½ parts gum arabic and about 270 parts water. This mucilage remains elastic when dried, and does not have a tendency to crack. Make up formula, using parts by weight. Write to the State botanist of Nebraska for information in regard to the flora of the State.

(5006) C. F. writes: I have a Climax burnisher which I purchased about three years ago. Scratches appearing on the burnishing iron are generally removed with finest emery cloth. I have frequently had occasion to apply this remedy with invariable satisfactory result. A short time ago, however, the steel surface of the burnishing iron seems to have become soft, and refuses to work without profuse scratches. I succeed in removing them and in polishing the surface again, but every trial at burnishing fills the instrument with scratches. I am positive that the fault is not with the photographs, as these burnish perfectly well with any other burnisher. Do you think that the softened steel is the cause of the trouble, and if so, how can I reharden it? A. Burnishing rolls are usually made of steel hardened or of chilled cast iron. In either case the repolishing of the surface would not make them soft. It may be possible the roll you have is case-hardened iron, which has only a thin hard skin, which when polished off leaves a soft surface. We advise you to address the makers of the burnisher.

(5007) G. M. S. ask how to melt gold and copper, and if an ordinary bellows will produce enough heat. I have a crucible and bellows, but when I tried to melt it I could not do it. Is there any chemical or anything I should put in it to keep it from oxidizing? A. You can melt a small quantity of gold or copper (1 pound) in any blacksmith forge by building a fire pot of loose brick to hold the fire close to the crucible. Use borax in the crucible to protect the metal.

(5008) W. K. writes: I have been experimenting considerably with primary batteries, and have experienced the usual quantum of disappointment and vexation with all of them. Have finally settled down to the Fuller as being on the whole as satisfactory as any, all things considered. I find that by placing in the porous cups one or two strips of zinc, the efficiency of the battery is vastly increased. I use two plates of carbon in each cell, 3 inches by 7 inches. Would it not be better to use in this battery cylinders of zinc, about the height of the porous cell, instead of the usual short cone or lump. I find that the strips of zinc keep well amalgamated. Would it be advantageous to further increase the carbon surface? A. In some forms of Fuller battery cylinders of zinc are used instead of conical pieces, but there is more or less waste in the use of pieces of this form. An increase of carbon surface adds to the depolarizing power of the battery.

(5009) J. K. says: 1. I wish to know what oil is best for fine leather shoes. Is castor oil good or injurious? Will oil keep rubber boots from cracking, and what kind? A. There is nothing better for softening shoe leather than neat's foot oil. Castor oil is much used, but is not the best. A very little neat's foot oil on rubber boots will soften the surface and make them less liable to crack. 2. Why do water pipes rarely burst when frozen under ground? A. Pipes partially protected in the ground freeze very slowly, which allows the water to move along the central line of the pipe and relieve the pressure, when the ice forming on the inside of the pipe can expand toward the center. If, even then, the pipe becomes frozen solid at two points, some distance apart, the intervening water upon freezing will burst the pipe. 3. What speed had a gang in a marble sawmill ought to run to do the best and most work? A. About 200 feet per minute. 4. In the marble quarry I work in there is a great pressure to the stone closing in on the drills of channeling machines and sometimes spoiling many dollars worth of marble. Can you give the cause? A. There is a constant compression in the rock crust of the earth, caused by the shrinkage of the earth through loss of heat—the same cause that has wrinkled its surface into hills and mountains, and caused even your marble quarries to become tilted in their stratified layers. When a channel is cut in the process, as with the channeling machine, where the drills cut a close-fitting channel, the pressure is relieved and the walls of the channel close in, although not enough to be readily seen, which can be measured and amounts to enough movement to pinch the gang drills.

(5010) M. & Son ask: 1. How to construct a cupola to melt about 200 pounds of cast iron, and what is put in cast iron to help melt it? A. A cupola to melt 200 pounds of iron should be about 24 inches external diameter, with a fire brick lining about 3 inches thick. It should be about 4 feet high. Cupolas of this size are generally suspended on trunnions, so that they can be turned down into a horizontal position for cleaning, etc. The bottom of the cupola should be hinged, so as to permit of dumping the contents. There should be a spout below the discharge opening, and upon each side of the cupola, about 10 or 12 inches above the bottom, there should be openings for receiving the blast pipes. We advise you to purchase a work on founding. We recommend "Founding of Metals," by E. Kirk, price $2.50; "Casting and Founding," by R. E. Spretzson, price $6; "Practical Iron Founding," price $1.50; "Iron and Steel Founding," by C. Wylie, price $2. Sometimes a little limestone or some oyster shells may be added to the coal and iron, to advantage, as a flux. This is generally done after the first charge. 2. How to construct a cupola to melt 200 pounds of wrought iron, and what is put in wrought iron to help melt it? A. Wrought iron cannot be melted and poured like cast iron. 3. What is the book to get on the manufacture of iron and steel? A. "Principles of the Manufacture of Iron and Steel," by I. L. Bell, price $8; "Chemistry of Iron and Steel Making," by W. M. Williams, price by mail $3.

(5011) E. B. C. writes: Does not a reducing valve always effect a waste of power? I have a boiler at 80 pounds and require to use a part of the steam at 40 pounds only. If I put in a reducing valve, do I not practically waste half the power of the steam so used? I have been told by several engineers, in whom I have confidence, that the waste under these conditions is very small—nothing like half; but it seems to me they are wrong. Substitute for the reducing valve an engine working on 80 pounds, with 40 pounds back pressure, and it would seem that a net gain equal to the work of the engine on 40 pounds should result. A. Either condition that you name is a most wasteful practice. If you have no use for the exhaust, make a reducing valve of the cut-off and use the whole boiler pressure on the piston for the shortest part of the stroke that will do the work. If you require as a necessity steam at half the boiler pressure for other purposes than power, it is proper to use a reducing valve for that purpose only, as where elevators have to be run with high pressure and the heating of buildings at low pressure. The running of engines with back pressure is also wasteful, only excepting that the exhaust steam can be used for its full value for heating or other purposes.

(5012) J. G.—You will improve the tin flux by adding 10 per cent of sal ammoniac to the muriate of zinc. Cover the surface of the tin with palm oil. You

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can also make tin more fluid by adding 5 per cent of bismuth. We have no books on this subject.

(5013) R. P. J. says: I have a 15 light incandescent dynamo which I am running with windmill power for charging 26 cells storage battery. I have trouble with the heating of the armature when the speed runs above 2,700—the required speed. The dynamo is shunt wound. Can I remedy the heating by introducing resistance into the shunt by arranging an automatic switch, to act when the speed exceeds 2,700 revolutions. If this will not answer, please make any suggestions that you think will help me. A. You can probably remedy the heating by the method proposed. The only alternative is to provide means for securing a closer regulation of the windmill or opening the circuit of the dynamo.

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AND EACH BEARING THAT DATE.

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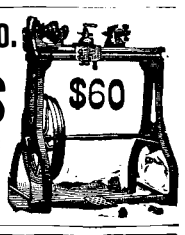

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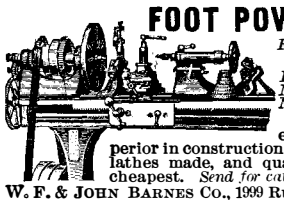

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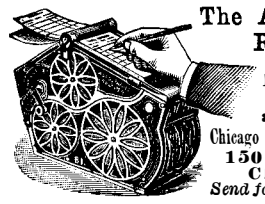

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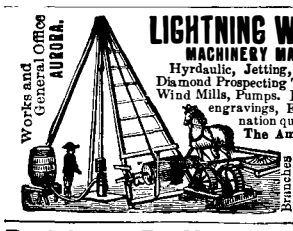

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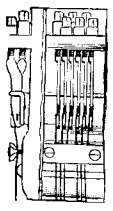

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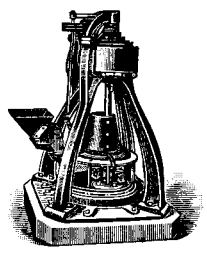

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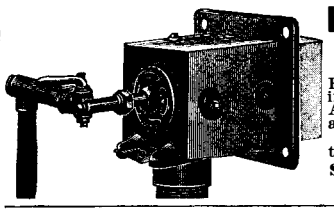

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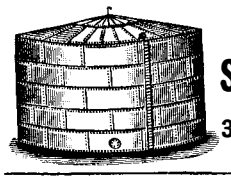

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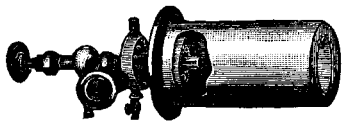

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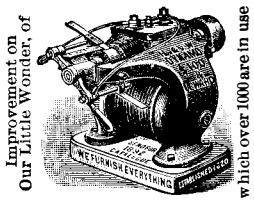

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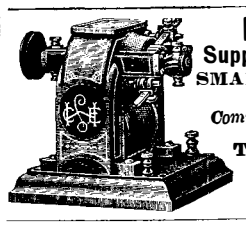

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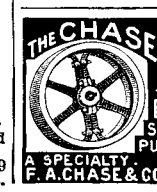

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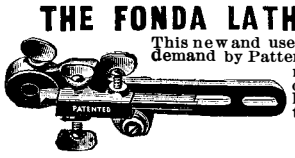

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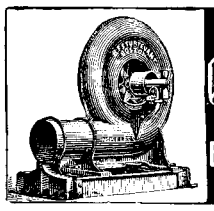

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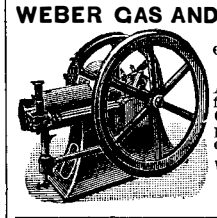

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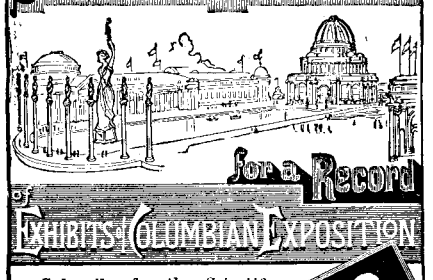

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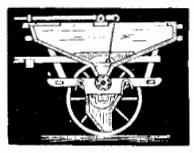

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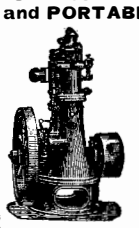

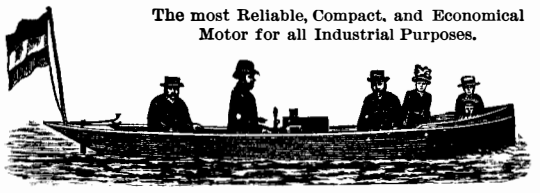

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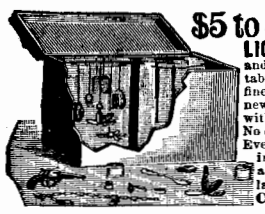

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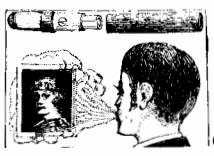

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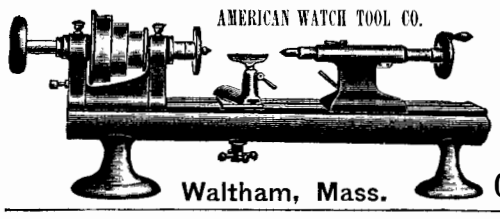

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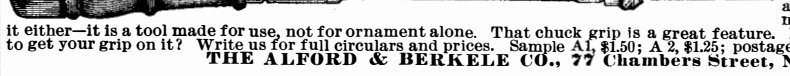

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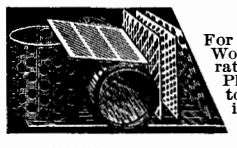

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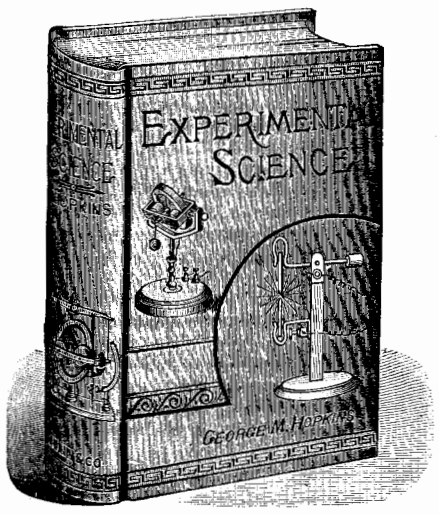

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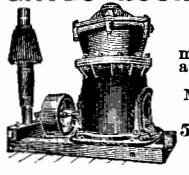

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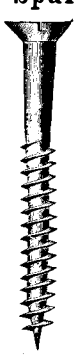

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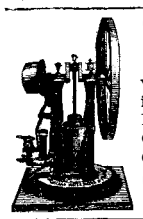

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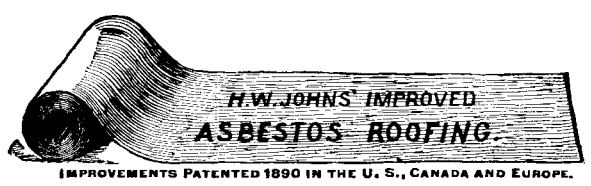

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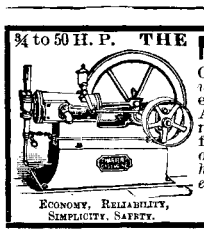

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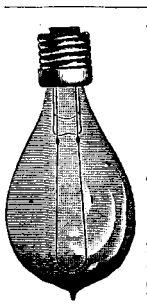

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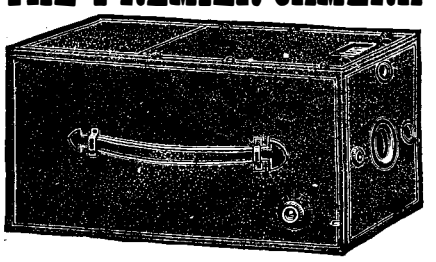

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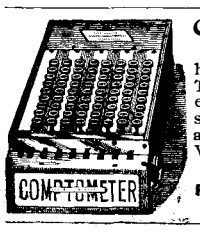

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